SCIENCE

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THE SIGNIFICANCE OF RADIUM [1]

We are met to-night to honor a discovery and the discoverer, and we are doing it in a way which I am sure delights her soul as much as it does mine. The custom of mankind, when it would do honor to one who has had the good fortune to be of service to his fellows, is to make a hundred thousand dollar parade, or to fire a hundred thousand dollar salute, or, in rarer instances of sounder judgment, to build a hundred thousand dollar monument. Compare that sort of an expenditure of the fruits of human toil with the glad donation which you are making to-night of a hundred thousand dollars, not merely for the alleviation of suffering and the arrest of disease—that is important—but for something which is vastly more important and more fundamental than that, namely, for the purpose of making it possible to peer farther into the secrets of matter, for upon that vision and the control of nature which that vision must precede depends the weal or woe of our children and our children's children for countless generations.

I wish to add a second element of uniqueness to this occasion. Knowing Madame Curie, as I have had the good fortune to do, I am sure that she would not wish me to speak a word of fulsome praise or to picture her as a superman; she is that because she is a woman, but not because she has had the capacity and the good fortune to make discoveries of the first importance. It is a common and a pathetic spectacle to see military, political, and social leaders who come conspicuously into the public gaze, lose their sense of perspective and begin to regard themselves as holding a commission from the Al-

[1] An address delivered at the National Museum, Washington, D. C., on the evening of May 25, in connection with the presentation of a gram of radium to Madame Curie.

mighty. I have never known a great scientist to make that blunder. And there ought never to be one who makes it because the business of science is to see things as they are. Madame Curie has always remained simple, modest and unaffected in the face of the world's applause. That is the highest compliment which a fellow scientist can pay her, and the surest sign that she is not an ordinary person. With that I have paid my tribute of respect and honor and admiration to the discoverer.

Now for the discovery. How did it come about? What is it? What is its significance immediate? What is its significance remote and far-reaching? In order to answer that series of questions I wish to begin by disabusing your minds of the idea, if they harbor it, that a discovery in science is an isolated event. A science grows in the main as does a planet by the process of infinitesimal accretion. Practically every experiment in physics is a modification of an experiment which has gone before. Almost every new theory is built like a great mediæval cathedral, through the addition by many builders of many different elements, one adding a little here and another a little there so that to the eye of a distant observer in the clouds the whole structure seems to move forward in a practically continuous way. Even when you get close up and begin to see the discontinuities, for they are there, each experiment in the development of a given field of science is found to have a pedigree just as truly as has a race horse. Man-o'-war did not develop his marvelous speed in one generation. A dozen sires and dams contributed to that result. In precisely the same way, when in 1896 Henri Becquerel, professor of physics in the University of Paris, discovered the new, extraordinary property which certain types of matter were found to possess and which was named radio-activity, that discovery was sired by one made a year before by Roentgen, and Roentgen's was sired by Leonard's; and Leonard's by that of Hertz in 1886, and Hertz's by the work of Maxwell, and Maxwell's by that of Faraday in 1831, and Faraday's by that of Oersted in 1819, and Oersted's by Volta's, and Volta's by Franklin's, and so on without limit. And the point to which I wish to call your attention now is that it is of incalculable importance that there should be people like those who have given this gramme of radium to Madame Curie who have a vision that extends, not to this generation only, but to the generations that are to come a hundred, two hundred years ahead, and who consciously set about starting such a train of scientific discovery and progress.

But for our present purpose I wish to break into this chain of scientific development at the discovery by Professor Becquerel of this extraordinary phenomenon of radio-activity made in the physical laboratory in which Madame Curie had been studying for some years. The discovery itself was really a simple thing, as are practically all great discoveries. The year before Roentgen had found his X-rays, as he called them, which had the peculiar property of making it possible for one to see his own skeleton. That attracted the world's attention and Professor Becquerel was endeavoring to see whether rays that would penetrate in that fashion could be produced from other sources. He naturally took uranium, because of its fluorescent property, to see whether it, under the action of light, might perhaps transmute the light waves into penetrating waves of the kind Roentgen had obtained. What did he find? He tried it in the light and he tried it in the dark, and he found that it was not necessary to have light at all, but that a bit of uranium put away in a black paper on top of a photograph plate, itself would blacken the plate. In other words, there was a property of self-activity in that uranium. It emitted rays of some kind which would affect a photographic plate and discharge an electroscope. The discharge of an electroscope, in popular language, is simply this: When you comb your hair on a cold winter day and it stands out in all directions, it is because it becomes electrically charged. If now a bit of radioactive substance is held above your head, your hair will fall down again, *i.e.*, your electroscope will be discharged. The laboratory electroscope is merely a gold-leaf which stands out like your hair when it

is charged and collapses when it is discharged. The electroscope then became the chief agent by which radio-activity could be tested, and Madame Curie with her husband—for she had been married the year before to Pierre Curie, professor of chemistry in the University of Paris—began the study of other substances than uranium to see how general this new property was, and they found that the two heaviest elements in nature, uranium and thorium alone of the then known elements, possessed it, but they also found that the natural ore of uranium, which we commonly call pitchblende, and which is more than fifty per cent. uranium oxide, although it contains many other minerals like barium and lead and bismuth—that this pitchblende discharged the electroscope approximately four times as fast as did pure uranium oxide. This meant, as the Curies at once interpreted it, that there must be some hidden elements in the pitchblende which had the same radio-active property as uranium but in larger degree. And so they began the search to see if they could not separate the element which was responsible for that activity, and after two or three years of arduous work Madame and Monsieur Curie were able to announce that, by using the ordinary methods of chemical analysis, by making precipitates and testing the activity both of the precipitate and filtrate to see with which the activity went and therefore what were the chemical properties of the substances that had it, they had been able definitely to discover the existence of these two new radio-active elements of which Dr. Walcott spoke. The first of these did not exist in sufficient amount so that it could be detected by any other properties than its activity. This was named polonium, in honor of the land in which Madame Curie was born, for her father was a professor in the Technische Hochschule at Warsaw. This polonium, by the way, has been one of our most useful agents in getting at the inner properties of the atom, because is has the power of emitting one type of ray alone and not a mixture of rays as does the other and more famous radio-active element which the Curies discovered. This other new element they named, appropriately, radium because it had a radio-activity a million times, weight for weight, that of the pitchblende, and three or four million times that of pure uranium.

This is the simple, unadorned tale of the discovery of radium, but I am sure you do not appreciate the kind of painstaking research and labor which that simple tale represents. You may perhaps get a little glimpse of what it means—of what a search for a needle in a haystack it was—when I say that the amount of radium in uranium is one part in 3,200,000; or that, in order to get the little gram of radium which is being presented to Madame Curie to-day it was necessary to take 500 tons of Colorado carnotite ore, which possesses two per cent. of uranium and to treat it with 500 tons of chemicals, apart from water and coal. So that, you see, the problem of bringing to a successful issue that search was one that places Madame Curie and her husband in the front rank of the world's scientific men and women.

The Nobel prize for 1903 was awarded jointly to Henri Becquerel and Monsieur and Madame Curie for their studies in radio-activity, and in 1911 the Nobel Prize was awarded to Madame Curie alone for isolating radium—getting it as a pure metal (in the early experiments it was a bromide or chloride), and for determining its atomic weight, which comes at 226.0. The heaviest element, uranium, has an atomic weight of 238, so that this is only twelve units lower than that.

So much for the way in which the discovery came about. But what is radio-activity? Perhaps I can tell you in as few words as possible by this simple statement. This gram of radium which you are giving to Madame Curie to-day, the volume of which is just that which I hold in my hand, and which you can see when the room is darkened—that gram of radium is continuously shooting off per second 145,000 billion particles which we call alpha particles, and with speeds which reach the stupendous value of twelve thousand miles per second. Now, when you recall that the super-guns which bombarded Paris could not

eject a projectile with a speed of more than about a mile per second, you see how feeble imitations of nature we have as yet been able to produce. No band of Mexican bandits running amuck on a Texas town can compare for a moment with a colony of radium atoms which perpetually bombard their neighbors with broadsides having muzzle velocities of 12,000 miles per second. Not only that; these atoms of radium have lighter ordnance also. They shoot off in addition each second 71,000 billion particles that are one eight-thousandth as heavy as these particles which I have called the alpha particles, and which are essentially helium atoms. If we call these alpha particles the 13-inch guns of the radium atoms, then we might say that they have also seventy-five millimeter guns which shoot off relatively light projectiles. These, however, have a speed which is more than ten times as great as that of the alpha particles. We call them beta rays. They are simply free negative electrons, endowed with a speed which is close to the speed of light, namely, close to 186,000 miles per second. But even that is not all. There is still one other type of rays that are being given off by this gram of radium. These other rays are the wireless waves of the denizens of the sub-microscopic world. They are ether waves just like light or just like wireless waves, except that the vibration frequency—the number of oscillations per second which the electronic inhabitants of the atom send off—amounts to thirty billion billions per second. These are the so-called gamma rays.

Now as to penetrating powers. The alpha rays or helium atoms, shoot right through the walls of a thin glass tube just as though there were no wall there at all, and that, in itself, has thrown new light on the structure of matter. It has shown us that the atom is itself an existence which is mostly empty space. It is like a miniature solar system through which it is entirely possible for a new satellite or planet to shoot without meeting anything. One of these alpha particles shoots on through hundreds of thousands of atoms before it is brought to rest. It goes through seven centimeters of air which is of the order of a third of a foot. That is as far as the heavy projectiles which are shot off from the radium atoms can go. The lighter ordnance shoots a hundred times as far and the gamma rays are a hundred times more penetrating still. I have thought you would be interested in actually seeing for yourselves the effects of these rays. I shall show first the effect of the gamma rays because, being those that are used in therapeutics, they are the ones you are most likely to be interested in. The gamma rays are simply ether radiations of very short wave-length, and whenever they pass through the atoms of matter they have the extraordinary power of ejecting with great speed from these atoms the electrons which are contained within them. And when these electrons pass in turn through other atoms they knock new electrons out of these atoms and thus put many of them into a condition in which they can make new combinations more readily than when they are not thus "*ionized.*" Now there can scarcely be any doubt that the therapeutic effects of radium are simply due to the fact that these ionized atoms have been put into a condition to make new chemical unions, *i.e.*, to produce new substances which are destructive of the normal tissues as well as of the cells of the disease which it is desired to destroy. But in some instances, at least, the disease is more susceptible than are the normal cells and consequently it becomes possible to arrest the growth of those disease cells. As a matter of fact, so far as the therapeutic effects of radium are concerned, the doctors who are in charge of the radium institutes will all tell you that you must not regard radio-active treatment as a cure for cancer. The only cure for cancer—the only certain cure—is surgical. Nevertheless, the effects of radium rays are to retard the growth of the malignant tumors and therefore to prolong life, so that, even in the case of cancers which are not capable of being operated upon —deep-seated concers—life can often be prolonged several years by radium treatment.

The medical specialists will also tell you that there are certain types of superficial tumors and skin diseases which can be perma-

nently and effectively cured, so that this kind of treatment has already been of sufficient use in therapy so that all who are familiar with it are at one in believing that it is highly desirable to introduce in all large centers of population these radium and X-ray hospitals of the kind which exist in Boston, New York, Chicago, Buffalo, Los Angeles, and several other cities, and which Paris is now to have because of the gift which you are making to Madame Curie.

The electroscope which by looking at the inverted image upon the screen you now see discharging rapidly under the influence of the gamma rays from the radium, is exposed only to the rays which have passed through more than a half inch of lead; for the radium is completely enclosed in lead walls of that thickness. This gives you some idea of the marvelous penetrating power of these gamma rays. I now wish to show you some of Dr. C. T. R. Wilson's photographs of the actual tracks of the alpha, beta and gamma rays through air. After seeing these straight line tracks of the alpha and beta rays you will not doubt that radium is actually shooting off big and little projectiles of the kind I told you about. The wiggly, snaky tracks due to the gamma and X-rays are perhaps even more interesting and enable you to visualize somewhat what goes on in your body when you are taking X-ray treatment. Can you now wonder that these rays tend to destroy the tissues and to produce burns?

Now a word as to the significance of this radio-active process. The therapeutic significance I have already referred to, but from my point of view the insight which radium gives into the nature of matter is of vastly more importance than any possible effects it has in the cure of disease or in the alleviation of pain. Twenty-five years ago if we had been told that any kind of matter possessed the property of throwing out projectiles with these enormous speeds we would have said "impossible." But not only in the enormity of the speeds of these projectiles is radium astonishing and revolutionary. There is something sublime about its ceaseless, unaltering and apparently unalterable activity, its complete indifference to intense heat or to extreme cold, to electrical or to chemical treatment of any kind. It is a property of the atom itself which we can not at present control in any way.

But the third effect of this discovery is more important still, for what does it show that matter is doing? These alpha particles which are being shot off are portions of the atom of uranium or of the atom of radium and the thing which is left after the ejection of the alpha particle from an atom of uranium is no longer uranium. Its chemical and physical properties have entirely changed. The uranium atom in shooting off one of these alpha particles is thereby transmuting itself into another element. When it has shot off three alpha particles it has transmuted itself into radium, and when it has shot off five more it has transmuted itself into lead. We have seen in the laboratory the growth of lead out of uranium, and have followed the whole chain of transmutation of elements through this radio-active process. This necessitates a conception of the nature of matter which was absolutely foreign to our thinking in the nineteeenth century, and it is revolutionary in its significance. It means that these "eternal" elements—this radium and this uranium which we have here—are not eternal at all. The average life of the atoms of this radium is just 2,500 years, and after that time the average atom will have disappeared as radium, and if the world's supply of radium has not then mostly disappeared it will be because new radium is being produced all the time out of uranium. But uranium is the heaviest element we know of, and what is happening to it? It too is disappearing. But whence came it? It is true that the average life of the uranium atom is approximately eight billion years, so that when you go back so far as that, you may be inclined to say that it doesn't make much difference to this particular Republican administration where it did come from. Ah, but wait! In your thinking you have been forced to admit for the first time in history not only the possibility but the fact of the growth and decay of the elements

of matter. With radium and with uranium we do not see anything but the decay. And yet somewhere, somehow, it is almost certain that these elements must be continually forming. They are probably being put together now somewhere in the laboratories of the stars. That is still something of a guess, it is true, and yet the spectra of the nebulæ show that they contain only the lighter elements. Can we ever learn to control the process? Why not? Only research can tell. What is it worth to try it? A million dollars? A hundred million? A billion? It would be worth that much if it failed, for you could count on more than that amount in by-products. And if it succeeded—a new world for man! But what have we got already through the discovery of radio-activity? An immensely stimulating new conception of the universe and of the way matter is behaving.

Next the significance of radium with respect to the question of the availability of energy. The amount of heat given off from one gram of radium in disintegrating into lead is 300,000 times as much as the amount of heat given off in the burning of one gram of coal. There is, then, in the radium a supply of sub-atomic energy, and this raises the question as to whether such energy exists locked up in other atoms and as to whether there is any possible way we can get at it? Do not be too sanguine about it as far as radium is concerned, because if all the radium at present in the world were set to work, although it is 300,000 times as potent as coal per gram in giving off energy, it would not suffice to keep the corner popcorn man's outfit going. It does not exist in sufficient quantity.

But what has its discovery done then in the field of energy? It has opened our eyes to the fact that certain kinds of matter certainly possess these stores of energy and it is almost a foregone conclusion that similar stores are also possessed by the atoms which we have not yet found to be changing—which are not radio-active. The astronomer has for years been completely puzzled to account for enormous amounts of energy which the sun and stars emit. He has not been able to find its source. It is impossible that the sun is simply a hot body cooling off, because we have evidence that it has lived longer than it could have lived if that were the case. The astronomer has now, however, seized upon the facts of radio-activity and surmises that these sub-atomic energies may be the source of the sun's radiation. If so the supplies are not so limited as we thought.

Look now at another side of this same problem. I am thinking particularly of the work of Professor Joly and Lord Rayleigh, who have made measurements of the amount of radio-activity of the ordinary surface rocks. Professor Joly has computed that if there are two parts of radio-active material for every million million parts of other matter throughout the whole volume of the earth, and this is considerably less than he has found on the average in the earth's crust, then this earth, instead of cooling off, is actually now heating up; so that in a hundred million years the temperature of its core will have risen through 1,800 degrees centigrade. That is a temperature which will melt almost all of our ordinary substances. What does it mean? It means that the life history of our planet is perhaps not at all what we have heretofore thought that it was. It means that a planet that seems to be dead, as this our earth seems to be, may, a few eons hence, be a luminous body, and that it may go through periods of expansion when it radiates enormously, and then of contraction when it becomes like our present earth, a body which is a heat insulator and holds in its interior the energy given off by radio-active processes, until another period of luminosity ensues. What I am now pointing out is the growth in our conception of the world, the growth in the thoughts of men that has come out from these studies. Do not think that this is not of importance. When Galileo discovered the moons of Jupiter he was doing just about as useless a thing from the standpoint of its immediate applicability to human relations as he could have found to do. And yet what did he actually accomplish? He started off the train of

thought, the mode of attack upon physical problems which has made this industrial age what it is, and therein lies the tremendous significance of a discovery of the kind which we are honoring to-night.

We are so close to this age in which we live that we do not see what it means; we do not see it in its relation to other centuries. And therefore I should like to take you up in an Einstein airplane that violates all the relations of space and time so that you may see with me a few spots in geography and in time. Suppose we sail first, in the present, to the banks of the Tigris or Euphrates and see a picture which Professor Breasted drew to my attention when he came back from a recent mission to the near east. He pictured the inhabitants of that region tilling the ground with a crooked stick, bringing their hard-earned produce to the shores of the river, putting it on crude rafts which were made from the skins of goats and sheep, and paddling it laboriously across to the other side. Then he threw on the screen a photograph of an ancient Babylonian tablet which showed the inhabitants of that region four thousand years ago doing exactly the same thing in exactly the same way. Four thousand years without a bit of progress—each generation simply following the last in living a miserable existence, reproducing its kind and then passing on. Leave that! It is a discouraging picture.

Fly over into India and see this! I heard last winter Mr. Sam Higinbotham describe the conditions prevailing in that land now, where, as he said, millions of men go out into the fields in the morning with only a handful of grain—all they have to eat for the day; work a long day in perpetual hunger and feel that they would be perfectly happy if they could get all they wanted of such raw grain to eat. What wonder that Heaven for these men is Nirvana—the escape from existence!

Now fly over China. To do so, you have only to look at the sign in front of this museum: "Millions starving to death in China unless they can get help from this western world!" Discouraging pictures! What is wrong with the world? Fly back to this country and perhaps the following sights may suggest an answer. Circle above the Mississippi near New Orleans, and contrast what you see with the picture on the banks of the Tigris. See a train on the Southern Pacific Road bearing five hundred tons of produce from Texas, pulled upon a great ferry without even uncoupling the engine. See it in fifteen minutes on the other side ready to distribute its huge load of food stuffs raised with the aid of automatic planters, tractor-plows and steam threshers on the broad plains of the west, to the millions of inhabitants in the eastern half of our country. Or, again, fly over the biggest copper mine in the world which is near Salt Lake City and look at a mountain of two per cent. copper being shoveled away by great steam shovels with comparatively little human labor. See forty thousand tons a day of ore pulled in huge hundred-ton cars a few miles to the mill. Then see one of those huge cars elevated, wheels and all with no apparent human assistance, sixty feet high, turned slowly over and made to dump its load of ore into the mighty mill where a great, senseless, iron Cyclops grinds it into powder. Then watch the unseen natural forces of cohesion and adhesion in the flotation process pick out the ore from the gangue, without human aid, though controlled by human brains, and thus produce from sources altogether unusable fifteen years ago, the cheapest copper which the world has ever seen, the copper with which you are now harnessing new water power and building new electric railroads across the continent, with which famine is made an impossibility in any part of these United States.

Now, what is the most essential and most significant element of difference betweeen the two pictures which you have seen, the one here, the other half way around the earth? In this country, where the giant forces of nature have been set at work, the cheapest paid laborer on a building or in a steel plant, or on a farm, got before the war for eight or nine hours of labor, and he gets now, more than twenty times as much, not merely in money but in actual goods to be purchased with his

money, as does that man in India or in China. In other words, the common, unskilled laboring man in America has more than twenty slaves, but they are senseless, iron slaves, each of the same effectiveness as a common Indian laborer, who are doing his work for him. Why? Because Galileo and a few men like him a few hundred years ago got the idea that it was important to study out how nature worked. It is that study which has resulted in this modern scientific and industrial age. And it is only in the regions of the earth where that idea has got started, namely, in Western Europe and in this country, where the conditions under which the average man lives and works have been thus alleviated. Note that I say " have been " not " are to be." True, they may be immensely more improved than they are now. I can see little, immediate, practical needs as well as you. But let us not yet alight from our airplane. When you look at what *has already be done* by the advance of modern science—by getting an idea into a few men's minds—you begin to see that, after all, the important thing in this world is not the immediately practicable; the important thing is the growth of the human mind, the development of a few big ideas. Other things come from that, and therein lies the far-reaching significance of the experiments with radium; they have opened our eyes to new possibilities; they have given us a new conception of the growth and decay of the elements, and of the possibility of the human control of these processes; they have revealed the existence of new sources of energy which some time we may hope to be able to tap, and with the aid of which we may perhaps enrich human life in as yet undreamed of measure.

The first step is to see whether it is possible by any means at our control, to disintegrate atoms. And we have already found that we can do it, and radium has helped us to make that discovery. But we have only begun on this type of work. Its possibilities are untold.

From my point of view there are two things of immense importance in this world, two ideas or beliefs upon which, in the last analysis, the weal or woe of the race depends, and I am not going to say that belief in the possibilities of scientific progress is the most important. *The most important thing in the world is a belief in the reality of moral and spiritual values.* It was because we lost that belief that the world war came, and if we do not now find a way to regain and to strengthen that belief, then science is of no value. But, on the other hand, it is also true that even with that belief there is little hope of progress except through its twin sister, only second in importance, namely, belief in the spirit and the method of Galileo, of Newton, of Faraday, and of the other great builders of this modern scientific age—this age of the understanding and the control of nature, upon which let us hope we are just entering. For while a starving man may indeed be supremely happy, it is certain that he can not be happy very long. So long as man is a physical being, his spiritual and his physical well-being can not be disentangled. No efforts toward social readjustments or toward the redistribution of wealth have one thousandth as large a chance of contributing to human well-being as have the efforts of the physicist, the chemist, and the biologist toward the better understanding and the better control of nature.

Finally, the most significant thing about this evening is the way in which this contribution to further progress has been made: Not through a public grant—that is not the method through which the genius of Anglo-Saxon civilization has ever expressed itself, but rather through private initiative. A large group of public-spirited people have, of their own free will, decided that they wished to have a part in the development of a new chain of scientific discovery. It is that spirit and that method which has made America what it is, and it is in the spread of that sort of intelligence among one hundred million people that our future lies.

R. A. Millikan

University of Chicago

LINCOLN WARE RIDDLE

THE following minute on the life and services of Professor Riddle was placed upon the records of the Faculty of Arts and Sciences of Harvard University at the meeting of June 7, 1921:

Lincoln Ware Riddle was born in Jamaica Plain, Mass., October 17, 1880. He graduated from Harvard in 1902, received the degree of A.M. in 1905, and of Ph.D. in 1906. In the same year he became instructor in botany at Wellesley College. He was appointed professor of botany there in 1917 and held this position for two years, when he came to Harvard as assistant professor of cryptogamic botany and associate curator of the cryptogamic herbarium. At the close of his first year of service upon our faculty he was attacked by the prolonged illness which terminated fatally on the 16th of last January.

The rare enthusiasm and singular devotion which he brought to his work were early made manifest. As a boy of twelve, at the Roxbury Latin School, he declared his purpose to devote his life to botany, and henceforth gave himself unreservedly to its pursuit.

At Wellesley he became deeply interested in lichens, and devoted himself more and more to the study of these plants. He made good use of the important lichen herbarium at Wellesley, and of the unique collection at Harvard, and in 1913, during a year's leave of absence in Europe, studied the collections in Upsala, Helsingfors, Geneva, London and Paris. His publications soon made him a leading authority on the subject.

He was constantly handicapped by a frail physique, but this did not prevent him from accomplishing important scientific work or from taking an active part in the affairs of the community. In his relations with his fellows he was the soul of honor and loyalty, with a personality that drew all men to him. In the class-room his sympathy and friendliness, as well as his clarity of style, made his teaching attractive. His devotion to his students was noteworthy and his influence great and lasting.

In the circle which mourns him his careful scholarship was widely esteemed by his professional associates; he was honored by all for his inspiring ideals, and, beyond the lot of most men, he was sincerely beloved.

WINTHROP J. V. OSTERHOUT,
ROLAND THAXTER,
MERRITT L. FERNALD,
Committee

SCIENTIFIC EVENTS

THE PRINTERS' STRIKE AND SCIENCE

IT is perhaps desirable to state that, owing to the strike of compositors for a forty-four hour week, the printers of SCIENCE continue to bring out the journal under serious difficulties. They have, for example, been unable to page the number of *The American Naturalist,* which should have appeared on May 1 and was in type at that time. Owing to the weekly publication of SCIENCE, it has been given precedence, the composition and make-up of the number having been largely done by the heads of departments. It has, however, been necessary to reduce the size of the numbers and to limit the amount of composition as closely as possible. Nearly all advertisers have cooperated with the publication department in using copy already in type and limiting as far as possible new composition. It may again be noted that the strike is nation-wide, affecting, in the east at least, the printing of most scientific journals.

GRANT FOR THE STUDY OF STELLAR PARALLAXES [1]

THE Advisory Council for Scientific and Industrial Research has quite recently granted an application made to it to assist in carrying out a piece of research work relating to the determination of the parallaxes of stars having a certain type of spectrum. The grant has been made to Mr. W. B. Rimmer, who up to the present has been employed in spectroscopic researches at the Imperial College of Science and Technology under the direction of Professor A. Fowler, but will now carry out this research at the Norman Lockyer Observatory at Salcombe Hill, Sidmouth. This observatory was founded by the late Sir Norman Lockyer in 1912, and the programme of work has been confined strictly to the photography of the spectra of stars and their subsequent classification according to his scheme of increasing and decreasing temperatures, which has been confirmed in its general features by the more recent work of Russell and Hertzsprung on giant and dwarf stars. The researches of Professor W. S. Adams have now

[1] From *Nature*.

rendered it possible to differentiate almost at a glance between a giant and a dwarf star. As a large amount of spectroscopic material was available at the Norman Lockyer Observatory for the application of Adams's method a trial research was begun. The method is based on a connection found by Adams to exist between the true brightness of a star and the intensity of certain lines in its spectrum. These line-intensities were determined by him by estimation, the plates being examined under a spectro-comparator. At the Norman Lockyer Observatory the method employed is to cover the lines gradually with a dark wedge, the position of which when a line is obliterated indicates the intensity of the line. The results of this trial research have proved very satisfactory, and were commented upon very favorably by Professor H. N. Russell on the occasion of a visit to the observatory. The above grant has been awarded to aid the extension of this research to all stars of suitable type down to declination —10° and of magnitude 6.5 and brighter. It is very opportune, for the staff of the observatory is small, and the work could not have been undertaken without such additional help.

HONORARY DEGREES CONFERRED BY YALE UNIVERSITY

At the commencement exercises on June 22 honorary degrees were conferred on several men of science. In presenting them Professor Phelps spoke as follows:

Master of Arts

Isaiah Bowman: formerly assistant professor of geography at Yale. Director of the American Geographical Society and editor of its *Bulletin*. He has led geological and geographical expeditions in South America. In 1917 he received the Gold Medal of the Geographical Society in Paris. He was the executive head of the house inquiry, being chosen for proved fitness. He did valuable work on boundaries for the Peace Commission in Paris. He is one more illustration of a college professor becoming so generally useful that the college is unable to keep him.

Doctors of Science

Hideyo Noguchi: distinguished Japanese scholar, M.D., Tokyo, 1897. He has made important discoveries in the treatment and prevention of smallpox and yellow fever. He is an honorary professor of three universities in South America; he has been given the Order of Merit by the Emperor of Japan. He is a striking fulfillment of the Scripture prophecy—"Seest thou a man diligent in business? He shall stand before kings." Dr. Noguchi has received the order of knighthood from three Kings—the Kings of Spain, Denmark and Sweden. Perhaps he appreciates even more than royal honors the admiration and gratitude of the people.

Madame Marie Curie: Marie Sklodowska was born in Warsaw and has always been a scientist; her father was a distinguished professor and her husband, Pierre Curie, will never be forgotten. She was educated at Warsaw and at Paris, and has been professor of radiology at Paris. It is superfluous to mention her discoveries in science, and now she has discovered America. She has often encountered dangers in scientific experiments, but nothing so dangerous as American hospitality; it is to be hoped she will not be a woman killed with kindness. She is unique. There is only one thing rarer than genius, and that is radium. She illustrates the combination of both.

Doctor of Laws

Sir Robert Jones: the leading British orthopædist. One of the many distinguished men contributed to the world by Wales. Lecturer on orthopædic surgery at the University of Liverpool; member of many learned societies, author of many books, recipient of many degrees to which number Yale is proud to add one more. Enormously useful during the war. He had charge of the orthopædic work of the British government 1914–1918. It is largely owing to him that England maintained during the war a position so characteristically upright.

James Rowland Angell: president-elect of Yale. Born in Vermont, a graduate of the University of Michigan. Professor and acting president of the University of Chicago. Exchange professor at the Sorbonne. At home anywhere and everywhere. Son of a great college president and ideally prepared to be one himself. Trained in scholarly research and in executive duties. A teacher of exceptional power. He has a thorough understanding of America's needs in higher edu-

cation and profound sympathy with Yale sentiment. A believer in physical and mental development; a scholar and a man. In choosing Dr. Angell as president, Yale has gone back to her earliest traditions, and, as was the case with her first five presidents, has taken a graduate of another institution. It was not until 1766 that a Yale graduate became president. Instead of having been a Yale man, he has spent his life preparing to be one.

HONORARY DEGREES AT HARVARD UNIVERSITY

HONORARY degrees were conferred at the commencement of Harvard University on June 23 on the men of science given below. In conferring these degrees President Lowell spoke as follows:

Master of Science

CARLOS CHAGAS, of Rio de Janeiro, Brazil. "Director of the Instituto Oswaldo Cruz, preeminent in the knowledge of tropical medicine in Brazil, discoverer of the nature and cause of the disease that bears his name."

Doctor of Science

SIR ROBERT JONES, of London, England. "The orthopædic surgeon who patiently and silently showed the way to restore to usefulness and comfort the cripples of the war."

GEORGE ELLERY HALE, director of Mt. Wilson Observatory at Pasadena, California. "Astronomer famous in two worlds, whose spectroheliograph has recorded light of the sun too strong and of the stars too faint for human sight."

HERBERT CHARLES MOFFITT, professor of medicine at the University of California. "The physician who built up for the University of California the great medical school of the Pacific Coast."

Doctor of Laws

JAMES ROWLAND ANGELL, new president of Yale University, Harvard A.M., '92. "A man tried in many posts, whose reputation has grown with every trial; worthy head of a university national in its scope, great in its history, great in its services to the nation, and greater still in its destiny."

SCIENTIFIC NOTES AND NEWS

PRINCETON UNIVERSITY, as well as Yale, Harvard and Columbia, has conferred the doctorate of laws on Dr. James Rowland Angell, president of Yale University.

THE degree of doctor of science has been conferred by Williams College on Dr. Henry Baldwin Ward, head of the department of zoology in the University of Illinois.

DARTMOUTH COLLEGE conferred at its recent commencement its doctorate of science on Dr. H. P. Talbot, professor of analytical chemistry at the Massachusetts Institute of Technology.

AT the commencement exercises of the New York State College for Teachers, Albany, on June 20, the honorary degree of doctor of pedagogy was conferred on Dr. C. Stuart Gager, director of the Brooklyn Botanic Garden. Dr. Gager delivered the address on June 18 at the unveiling of the bronze tablet in memory of students of the State College who lost their lives in the war.

THE degree of doctor of laws was conferred upon Dr. C. H. Mayo at the commencement exercises of Northwestern University on June 15.

DR. W. J. MAYO delivered the Henry Jacob Bigelow Medalist Address before the Boston Surgical Society on June 6, at which time he was awarded the Bigelow Gold Medal. The Henry Jacob Bigelow trust fund was established in 1916 by Dr. William Sturgis Bigelow, of Boston, in memory of his father, the income to be used by the Boston Surgical Society to award medals for valuable contributions to the advancement of surgery in this country or in other countries. Dr. Mayo is the first recipient of the medal.

DEAN THOMAS F. HOLGATE, of Northwestern University, has been invited by the University of Nanking, China, to spend his sabbatical year at that institution, lecturing on mathematical subjects and assisting in the general organization of the university. He sails for China on August 18 on the Empress of Asia.

DR. MARK F. BOYD, professor of bacteriology and preventive medicine in the Medical Department of the University of Texas since 1917, has resigned to enter the service of the International Health Board of the Rockefeller Foundation.

Dr. Juan Guiteras, formerly director of public health of Cuba, has been appointed secretary of public health and charities.

Dr. Edward B. Krumbhaar, assistant professor of research medicine in the University of Pennsylvania, has resigned to become director of the pathological laboratory of the Philadelphia Hospital.

Dr. J. F. Dillingworth, who, for the past four years, has been under engagement with the Queensland government, investigating pests of sugar cane, is returning with his family to their home in Hawaii. For the present his address will be University of Hawaii, Honolulu, T. H.

The commencement address at Clark University was given on June 13 by Dr. John M. Clarke. The occasion was the first commencement under the presidency of Dr. Wallace W. Atwood.

At a public meeting of the British National Union of Scientific Workers on May 25, Professor L. Bairstow gave an address on "The administration of scientific work."

At the meeting of the Physical Society of London on June 10, Sir Ernest Rutherford delivered a lecture entitled "The stability of atoms."

Sir Napier Shaw gave the Rede lecture of the University of Cambridge on June 9 on the subject of "The air and its ways."

Colonel John Hershel, F.R.S., formerly of the Indian Trigonometrical Survey, died on May 31 at the age of eighty-three years.

The death is recorded in *Nature* of Miss Czaplicka, who went from Poland to Oxford in 1910 with a scholarship in Summerville College. She has since conducted explorations in Siberia and has been lecturer on ethnology at Oxford and Bristol.

UNIVERSITY AND EDUCATIONAL NEWS

Gifts and bequests to Yale University in the past year aggregating $1,859,154 were announced at the alumni luncheon by President Hadley. Of this amount, $545,729 was from the alumni fund, the report of which showed more than eight thousand contributors during the year.

The California Legislature has appropriated $500,000 for building and equipping a new physics building for the University of California. Work has begun on the plans, and it is hoped that the building will be ready for occupancy by December, 1922. Liberal provision will be made for research, both in space and equipment, and ample laboratory accommodations will be provided for the undergraduate students, who have more than doubled in number during the past two years.

Mr. Samuel Mather has given to Western Reserve University $500,000 to be used in the construction of a building for the medical college.

Mrs. Ransohoff, widow of Dr. Joseph Ransohoff, former professor of surgery at the Medical College of the University of Cincinnati, has given $25,000 to this institution (*not* Cornell) toward the endowment fund for the establishment of "The Joseph Ransohoff Professorship of Surgical Anatomy," or if such is not feasible "to endow the Joseph Ransohoff Fellowship of Surgery." Effort is under way at the present time to secure the added $125,000 for the total endowment above mentioned.

The resignation of Dr. Russell H. Chittenden, director of the Sheffield Scientific School of Yale University, to take effect at the end of the college year has not been accepted by the trustees, and has been postponed to July, 1922.

Professor Dan T. Gray, of the North Carolina Experiment Station and Extension Service, has been elected dean of the Agricultural College and director of the Experiment Station of the Alabama Polytechnic Institute.

Recent appointments in Colorado College include A. W. Bray, as assistant professor of biology, and James H. C. Smith, as assistant professor of chemistry.

DISCUSSION AND CORRESPONDENCE

USE OF THE TERMS "EROSION," "DENUDATION," "CORRASION" AND "CORROSION"

I AM interested in Mr. Bissell's plea for a more precise term, in geological literature, of the terms, "erosion," "denudation," "corrosion" and "corrasion." Without entering into a discussion of the merits of various past definitions of these words, may I presume to express my own views on this subject?

"Erosion" means "gnawing away," and is properly used to include all natural processes which have their origin at the earth's surface and which involve the destruction of rocks at or near the earth's surface. This is the broadest term referring to surficial rock destruction. It embraces work performed by passive or motionless agents (weathering) and work performed by moving agents, such as running water, glacial ice, waves, and wind. It may be used correctly for rock destruction on the land or on the sea floor. Thus, we may speak of erosion of the sea floor by waves or by submarine currents, and of the erosion of rocks, exposed on land, by moving ice or by alternate contraction and expansion due to heating and cooling, etc., etc. While it must connote transportation and may connote deposition, it should not be used to include these dependent processes.

"Denudation," by derivation, refers specifically to *stripping* or *laying bare*. It is often used in the sense of natural removal of soil or mantle rock from underlying solid rock, or removal of one rock formation from one lying below. It refers to erosional processes which are destructional, and like erosion should not be used to denote transportation or deposition. Almost, if not quite, without exception, "denudation" refers to stripping (erosion) only on land, whether it is on a small scale or on a large scale.

"Corrasion" is mechanical erosion performed by moving agents such as wear by glacial ice, by wind, by running water, etc.

"Corrosion" is most commonly used for chemical erosion, whether accomplished by motionless or moving agents.

I have suggested the foregoing definitions always having in mind that the "rock" eroded may be consolidated or unconsolidated and that corrasion is accomplished largely by virtue of sand, silt, or other rock debris carried by the moving agent of erosion.

FREDERIC H. LAHEE

DALLAS, TEXAS,
May 11, 1921

THE BREEDING HABITS OF AMBYSTOMA TIGRINUM

THE eggs of *Ambystoma tigrinum* are usually described as occurring in small clumps. This is typical of the species in the eastern part of its range. While collecting in Colorado at an altitude between 6,000 and 7,000 feet, I found eggs of *tigrinum* laid singly. When first laid the egg resembles that of *Diemictylus*. As development continues the outer envelope becomes swollen until at the time of hatching its diameter is one half to three quarters of an inch. The eggs are attached to vegetation or debris. The depth varies from a few inches to two feet. On one occasion adults brought into the laboratory laid freely.

RALPH J. GILMORE

COLORADO COLLEGE,
COLORADO SPRINGS, COLO.

A PHENOMENAL SHOOT

AN extraordinary water-shoot, discovered by Mrs. B. W. Wells, near the city of Raleigh, N. C., on March 21, 1920, is of such unusual size as to deserve recording. The shoot sprang from the side of the trunk of a beheaded tree of *Paulawnia tomentosa* (Thunb.) Steud. and grew in one season (1919) to the length of 19 feet, 5 inches. Twenty internodes were formed, the longest of which, located a little below the middle of the shoot, measures 19 inches in length. The base of the shoot is 7.75 inches in circumference and 2.5 inches in diameter. Braunton in Bailey's Encyclopedia of Horticulture gives 14 feet as a maximum length of *Paulownia* shoots growing from the root after winter killing. The shoot recently discovered, exceeding this by 5 feet, 5 inches, is believed to be a record for

the tree type of woody plant in the temperate zone.

B. W. Wells
North Carolina State College

THE AURORA OF MAY 14, 1921

To the Editor of Science: A very fine display of northern lights was observed here on Saturday night May 14th to daylight Sunday morning. It was first observed at 8:30 P.M. and was most conspicuous in extremely bright patches here and there in the sky, lasting usually not over a minute, with long arcs crossing the northern horizon. It was slightly cloudy, especially overhead and toward the northeast, but bright patches of aurora could be seen through the clouds. The sky was clear in the west and here and there groups of fine lines were visible, having always a slant of 60 degrees from the horizontal, corresponding to the dip of the compass at Tucson.

The colors were a dull white changing to a greenish tint in the northerly glows, a brilliant pearly luster in the patches and an occasional strong red color over large indefinite areas.

The display appeared to become somewhat less intense at 10:30 but shortly afterward showed renewed activity especially in long lines extending over large parts of the sky, which was now nearly clear, and all pointing toward a vanishing point of perspective situated about 30 degrees south of the zenith and a little to the west of the meridian, which is the direction of our lines of magnetic force extending toward the south pole. This vanishing point was very beautiful and was observed by many people. By one o'clock the display had somewhat diminished, but a later view at 3:30 showed a perfectly clear sky and the ordinary arcs crossing the northerly horizon with occasional nearly vertical streamers extending upward.

This was observed in many other parts of Arizona and far exceeds the recollection of anything of the sort seen here in forty years. I have notes upon four previous occurrences. One was seen from Flagstaff, Arizona, in the winter of 1894 and 1895. One was reported to me on November 5, 1916, and faint displays were seen here on October 9 and December 13, 1920. This was the first display of northern lights for most of the people of this part of the country.

A. E. Douglass
Steward Observatory,
The University of Arizona

THE AURORA SEEN FROM SINALOA, MEXICO IN LATITUDE 27° N.

The Northern Light display of May 14 was very plainly visible from the mesa here—only a few miles from the tropics. The Indians have been firing the forests to hasten the advent of the summer rains, and, when I first observed the glow along the sky-line formed by the Sierra Madre I thought they were indulging in their propitiation of the gods on a rather larger scale than usual. The glow began about eight o'clock and the rays were first visible about fifteen minutes later. They were white to pale yellow in color, ever changing in form, location, and brightness. Many of them appeared to reach an east-and-west great circle through the zenith, those low down in the eastern sky appearing longer. The apparent focus was several degrees east of north.

I had never before witnessed such a display and never expected that my first observation of the aurora would be from the semi-tropics.

J. Gary Lindley

QUOTATIONS

THE MOUNT EVEREST EXPEDITION

The organization of the expedition is now complete, and all the members proceeding from England have left for India. The leader of the mountain party, Mr. Harold Raeburn, sailed from Birkenhead direct for Calcutta on March 18. Colonel Howard Bury, chief of the expedition, left Marseilles for Bombay on April 9, and Mr. G. H. Leigh Mallory, one of the young climbers, sailed from London direct for Calcutta on the preceding day. Mr. A. F. R. Wollaston, surgeon and naturalist, left Marseilles for Bombay on April 16, and by the same boat Mr. G. H. Bullock, who had been selected at the last moment to replace Mr. George Finch, who was unfortunately, owing to ill-health, unable to take part in the ex-

pedition this year. These gentlemen, with Dr. Kellas, who is already in India, complete the party of six from this country who will make the reconnaissance, and will, if conditions are favorable and the reconnaissance has clearly revealed the best route, make an attempt this year to reach a considerable height on the mountain. The survey operations will be entirely in the hands of the Survey of India, and we learn from the surveyor-general that Major Morshead and Captain Wheeler were under orders to leave Darjeeling about April 1 to carry forward a good triangulation on to the plateau of Tibet with a view to the ultimate determination of the deviations of gravity north of the Himalaya, the question of the first importance to Indian geodesy. At the request of the government of India an officer of the Indian Geological Survey will also accompany the expedition. The commander-in-chief in India, Lord Rawlinson, has responded very kindly to the request that he should assist the expedition by the loan of transport, and a letter has been received recently from the quartermaster-general detailing orders which have been issued for the selection of trained mules and their accompanying personnel. The transport train was to have assembled at Darjeeling on May 12, and the value of this assistance can hardly be overestimated.

At a recent party at Buckingham Palace the president was summoned both by the King and Queen to give them the latest news of the organization and plans of the expedition, and His Majesty has graciously shown his kind interest in the project by contributing the sum of £100 from the Privy Purse to the expedition's funds. The chief of the expedition, Colonel Howard Bury, was received before his departure by H.R.H. the Prince of Wales, Vice-Patron of the society, who, with the Duke of York, spent an hour examining the plans of the expedition, and expressed his keen interest and good wishes for its success; an expression that was followed almost immediately by a generous contribution of £50 to the funds of the expedition.

As a result of the appeals made by the president of this society and the Alpine Club a sum has been collected which is approximately sufficient for the work of the first season, but leaves little reserve. It is, therefore, greatly to be desired that all fellows of the society who are jealous for the success of the first important enterprise undertaken since the war, should, if they have not already done so, send subscriptions according to their means to the funds of the expedition.—*The Geographical Journal.*

SPECIAL ARTICLES

AN OUTLINE FOR VASCULAR PLANTS [1]

If an attempt is made to prepare a numbered list of the orders and families of flowering plants, there should first be some agreement on the sequence of the major groups. For example, should the monocots precede or follow the dicots? Should gymnosperms and ferns be included in the enumeration, as they are included in our manuals? Unless these points are agreed upon, the enumeration will be premature.

It will first be necessary to bring together the work of anatomists, morphologists and systematists. A list prepared in this way should command the respect of all botanical workers, and all might be expected to follow the list. If this synthetic view is taken, we find the ferns, gymnosperms and angiosperms forming coordinate groups. And this series stands in coordinate relation with the lycopods and horse-tails taken together. It remains for some authority on taxonomy to embody these conclusions in the system. With a view to bringing such a system under criticism, we offer below a tentative arrangement of the larger groups of plants. If some such system is adopted—as must ultimately be—we could best number the orders and families of each class separately. Thus ferns and gymnosperms would have separate numerals from those allotted to angiosperms. It is to be hoped also that the dicots will be given a permanent place at the beginning of the angiospermic series. The entire series of vascular plants would appear thus:

[1] *Cf. Plant World*, 22: 59–70. March, 1919.

Lycopsida
  Order 1. Lycopodiales
    2. Equisetales
Pteropsida
  Class 1. Aspermæ (Ferns)
    2. Gymnospermæ
    3. Angiospermæ
   Subclass 1. Dicotyledoneæ
    Division 1. Archichlamydeæ
     Order 1. Casuarinales
      Family 1. Casuarinaceæ

. . . .

    Division 2. Metachlamydeæ
   Subclass 2. Monocotyledoneæ
     Order 41. Pandanales

. . . .

       51. Orchidales
      Family 284. Orchidaceæ

HENRY S. CONARD

GRINNELL, IOWA,
May 16, 1919

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

Studies in fluoride equilibria: I. Calcium borofluoride: A. F. O. GERMANN and GILBERTA TORREY. Moissan, in his work with boron trifluoride, passed the gas through a tube containing heated calcium fluoride, presumably to free the gas from any hydrogen fluoride that might contaminate it. Calcium borofluoride, $Ca(BF_4)_2$ is described in the literature, and it seemed reasonable to expect the formation of a similar compound under the conditions of Moissan's work. To determine this, weighed samples of calcium fluoride were heated for several days at a temperature of 200° C. in an atmosphere of pure boron trifluoride under a pressure of 430 mm. Absorption took place slowly, and until one half molecule of the gas was absorbed. Blanks were run to determine the amount of absorption by the glass, etc., of the reaction tube; this absorption was found to be slight. The compound, $2CaF_2.BF_3$, forms by direct union of the constituent molecules under the conditions outlined.

Chromatic emulsions: HARRY N. HOLMES and DONALD H. CAMERON. A "solution" of ordinary cellulose nitrate (11 per cent. nitrogen) may be somewhat diluted with benzene and then emulsified with glycerol. A creamy white emulsion of drops of glycerol in the other liquid results. With addition of enough benzene the indices of refraction of the two liquids may be made equal, thus securing a transparent emulsion. With the right amount of benzene a very beautiful yellow emulsion which is a soft blue by transmitted light is produced. The next step up in the "color chromatic scale" is a pink emulsion which transmits green light. Next a lavendar emulsion is made transmitting yellow light. With still more benzene a blue-green emulsion is secured with a sunset red glow by transmitted light. The colors are explained by the great difference in dispersive power of the two liquid phases, transparency being fundamentally necessary to let the light through.

Cellulose nitrate as an emulsifying agent: HARRY N. HOLMES and DON H. CAMERON. By the use of cellulose nitrate as an emulsifying agent emulsions of the "water-in-oil" type may be prepared. Cellulose esters containing about 11 per cent. nitrogen are most suitable. "Water-in-oil" emulsions are far less stable than the more usual "oil-in-water" type. To prepare the former such emulsifying agents as calcium and magnesium soaps, lanolin, carbon and rosin have been used. However, cellulose nitrate is far superior to these agents in the stability of the emulsions produced by its aid. For example, if water be shaken with a suspension of cellulose nitrate in amyl acetate (2 per cent. is suitable) a good white emulsion of drops of water dispersed in amyl acetate is obtained. Instead of amyl acetate any liquid that peptizes ("dissolves") the cellulose ester may be used provided also the two liquids are immiscible. One of the important factors in the formation of this emulsion is the formation of a tangible film around each drop. With a very large drop the film may be observed under suitable conditions. It is probably formed by great adsorption, to the point of coagulation of the cellulose nitrate at the liquid interface.

A theory of the photographic latent image: HARRIS D. HINELINE. The suggested theory concerns itself with the latent image as distinct from the photo-electric effect on the silver halide, and as distinct from the print out image. A reaction between the dissociation products of the silver halide and gelatine which will yield energy enough to account for the energy discrepancy pointed out by other workers, is suggested. In terms of this theory the latent image then consists of a combination between the bromine and substituted ammonia of the gelatine and the silver and amido acid, the amido acid compound being much more easily reducible than the bromine compound of

silver. This theory can account for the failure of the reciprocity law, for the shape of the H and D curve, for the phenomenon of reversal, and states the distinction between the latent image and the print-out image. The energy relationships are such as to indicate the formation of a considerable proportion of silver amido acid compound, which then becomes the material affected by the developer.

The interaction of platinum hydrogen acid and hydrogen peroxide: S. A. BRALEY and O. V. SHAFFER. Following the work of Rudnick in 1917 a study of the preparation of H_2PtCl_6 was made. It was found that commercial 3 per cent. H_2O_2 acted only very slowly on ignited platinum black, and on platinum sponge did not give H_2PtCl_6 suitable for accurate analytical work. By concentrating to about 30 per cent. and redistilling from quartz to quartz H_2O_2 was prepared which would give acid with a KCl factor of .3045 and suitable for accurate KCl determinations.

Is there a sharp transition point between the gel and sol? EUGENE C. BINGHAM. The viscometer gives a satisfactory method for distinguishing sharply between a liquid and a solid. Under the influence of a small shearing stress a liquid is continuously deformed, whereas a solid is not. The fluidities of a 10 per cent. gelatine sol in glycerol-water mixture of 1.175 sp. gr. calculated from the data of Arisz follow the equation

$$\phi = 0.000227 \quad (t - 45.2)$$

very closely. This indicates that the fluidity would reach the zero value when the temperature becomes 45.2° C. At this point the substance would become a solid and there would appear to be a sharp transition point between the two states.

The validity of the additive fluidity formula: EUGENE C. BINGHAM and DELBERT F. BROWN. It is shown that in many mixtures of inert liquids there is a contraction of liquid in mixing. If this contraction is multiplied by a constant, which is usually about 2,000, one obtains the amount by which the observed fluidity differs from the value calculated on the additive formula. It is evident from the above that even in the case of so-called inert liquids there is an adjustment of the free volume, for which several equations have been proposed. These give as good agreement as can be expected with the data available.

The emulsion colloids as plastic substances: EUGENE C. BINGHAM and WILLIAM L. HYDEN. The fluidity-volume concentration curves of suspension colloids were found to be linear by Bingham and Durham, and the zero of fluidity served to demarcate between the viscous liquid and plastic solid. Nitrocellulose solutions in acetone present a new case, differing from all others studied up to the present. The fluidity of even very dilute solutions is not a constant but a function of the pressure. The solutions, therefore, act as plastic solids even in very dilute solutions. It is found to be convenient to measure the plasticity of such solutions in the viscometer. This has heretofore always been done on the plastometer.

The properties of cutting fluids: EUGENE C. BINGHAM. In cutting metals, fluids are often used, sometimes to lower the temperature, often to lubricate the surfaces between the tool and the chip. But whereas lubrication under the best conditions is merely a matter of viscosity, two oils of the same viscosity may have the most extraordinary difference in efficiency. The cutting oil *par excellence* is lard oil and it derives its superiority from its high *adhesion*. Mineral oils may have their lubricating efficiency raised by the addition of substances having high adhesion.

The diffusion of hydrogen through silica glass: JOHN B. FERGUSON and G. A. WILLIAMS. The results of a redetermination of the rates at which hydrogen will pass through silica glass at temperatures between 440° and 727° C., and at pressures between 0.5 and 1 atmosphere are herein presented. The fact that helium will pass through silica glass at a much faster rate than does hydrogen has been confirmed.

The atomic weight of nitrogen by the thermal decomposition of silver trinitride: HAROLD S. BOOTH. In this determination silver trinitride was slowly decomposed by heat in a suitable all-glass apparatus into silver and nitrogen, the evolved nitrogen passed through phosphorus pentoxide to absorb the traces of moisture retained in the interstices of the silver trinitride, and the nitrogen adsorbed in a charcoal tube immersed in liquid air. The method as planned involved no corrections except for errors in the weights. Every precaution was taken to insure the purity of the materials and the accuracy of the method. The average of fourteen determinations of the ratio 3N : Ag gave 14.007 for the atomic weight of nitrogen.

Studies in adsorption from solution: W. A. PATRICK and D. C. JONES. A study of adsorption in the capillaries of silica gelatine of a large number of two component systems has been partially

completed. A range of liquids from water up to the high petroleums has been investigated. The results have been examined in the light of existing theories. Qualitatively they appear in agreement with the Gibbs relation, those substances being adsorbed that lower the interfacial tension. Qualitatively they can not be represented at all by the Freundlich equation. A theory is advanced that solubility and the effects of the enormous curved surfaces present in the capillary pores are the determining factor.

Summary of study of system ammonia-water: W. A. Patrick and B. S. Neuhausen. (1) A static method has been developed for measuring the partial pressure of a component which is relatively very small compared to the partial pressure of the second component. (2) This method has been used to determine the partial pressures of water and ammonia of concentrated ammonia solutions at 0° C., 20° C., and 40° C., at partial pressures of ammonia varying from 1,000 to 4,000 mm. The partial pressures of the ammonia were measured to within 4 to 2 millimeters; and those of the water to 0.08 millimeter. (3) The solubility of ammonia in water was determined at 0° C., 20° C., and 40° C., at pressures from 750 to 3,600 mm. The densities of these solutions were also determined. (4) A theory of the nature of solution of gases in liquids first advanced by Graham has been amplified, and solutions of various gases in liquids classified on the basis of some of the physical and chemical properties of the gas. (5) The formula

$$V = K\left(\frac{P6}{Po}\right)\frac{1}{n}$$

has been found to represent well the solubility of ammonia in water at varied temperatures and pressures. In this formula V is the volume occupied by the liquefied gas dissolved per gram of water; p is the vapor tension and 6 the surface tension of the liquefied gas at the temperature while p is the equilibrium gas pressure. The constant k for ammonia has the value 0.49 and $1/n$ has the value 0.69.

Heat of wetting of silica gelatine: W. A. Patrick and R. C. Grimm. The amount of heat liberated when silica gelatine is wetted by a number of liquids has been accurately measured in an adiabatic calorimeter. The results have been examined from the standpoint of the surface energies involved. On the assumption that silica gelatine presents a surface that is essentially water, all of the experimental results were capable of being brought into agreement with the idea that the heat of wetting is essentially a manifestation of changes of surface energy. The heat of wetting of water between 0° and 4° was found to be positive and greater than that at 20°.

Adsorption by precipitates. IV. Acclimatization: Harry B. Weiser. The amount of electrolyte required to coagulate a colloid is influenced by the rate of addition. Since the quantity of electrolyte that will cause complete coagulation when the addition is rapid will not cause complete coagulation when the addition is slow, the colloid is said to become acclimatized and the phenomenon is called "acclimatization." This term is a misnomer. The dropwise addition of an electrolyte throughout a prolonged period is accompanied by fractional precipitation of the colloid. The excess electrolyte required to precipitate a colloid by the slow process is due to removal of precipitating ions by adsorption of the neutral particles during fractional precipitation. The factors which determine the excess electrolyte required for a given slow rate of addition are: (1) the extent to which the colloid undergoes fractional precipitation; (2) the adsorbing power of the precipitated colloid; and (3) the adsorbability of the precipitating ion.

The oxidation and luminescence of phosphorus. III. The catalytic action of vapors: Harry B. Weiser and Allen Garrison. Phosphorus trioxide is an intermediate product in the complete oxidation of phosphorus. The luminescence of phosphorus is due to the oxidation of this lower oxide. Certain vapors inhibit the oxidation of phosphorus and others accelerate the oxidation. Such substances are designated as catalysts, but they are not catalysts in the ordinary sense in which this term is used. The vapors are condensed or adsorbed on the charged or uncharged oxidation products of phosphorus (P_4O_6 and P_2O_5). If the vapors react with phosphorus trioxide they increase the rate of oxidation. If they are inert, they prevent further oxidation of phosphorus trioxide and also form a cloud near the surface of the phosphorus. This cloud approaches nearer and nearer the surface as the oxidation becomes less energetic and in certain cases may form a protecting film that stops the oxidation entirely.

Critical solution temperatures as criteria of liquid purity: D. C. Jones. (By title.)

Charles L. Parsons,
Secretary

SCIENCE

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THE UNIVERSITY AND RESEARCH [1]

The main sources of research in America have been, and must continue to be, the universities. We have a few first class special research institutes; and we have a good many laboratories of industrial research and development. There are more of these than is popularly known; five hundred, perhaps, counting many small ones. But their work is directed more towards the attack of specific problems of development in the special industries which support them, and less towards the fundamental science that underlies these industries. In some of the larger of these industrial research laboratories, however, able investigators are at work and fundamental research of a high quality is carried on. But in all of the few special institutes and the many industrial laboratories taken together the research output is much less than that which comes from the universities. In addition, of one thing very important to the maintenance of research in the country these special institutes and industrial laboratories do almost nothing at all. That is the development and training of new research workers. This is done almost exclusively in the universities and colleges. Anything, therefore, which lessens the interest and activities of the universities in research, and hence reduces their actual output of research and research workers, is a menace to our national strength and well-being. For this strength and well-being depend, in a very large measure, on scientific research and discovery.

The conspicuous role played by science in the war from its very beginning, and the pressing necessity for solving serious war problems involving scientific investigation, brought very

[1] A paper read at the educational conference, May 13, 1921, held at the University of Minnesota, in connection with the inauguration of President L. H. Coffman.

vividly to the attention of the world the advantage to a nation of large scientific resources, both in equipment and personnel, and of being able to mobilize quickly and effectively these resources to aid in meeting the great emergencies created by war conditions.

At the beginning of the war Germany revealed herself far better prepared than any other country to take swift advantage of her scientific resources. In my interesting conversations in 1915 and 1916 with officers of the German General Staff at their great headquarters in occupied France, where I had to reside for some months as chief representative for occupied France of Mr. Hoover's relief organization, I was much impressed by the reliance placed by these officers on the help they were receiving and could always expect to receive from Germany's scientific men. When things were going badly on the West Front they would say: "Well, just wait; our scientific men will give us something new. They are all organized; they are all working; they will have something new soon to make your eyes stick out."

It is familiar history now that Germany's science, brought to the aid of her armies and navy, did repeatedly make our eyes stick out, and it was necessary before the war could be won to meet German's science with English and French and Italian and American science. We and the Allies had to organize science, too, and, with a haste made desperate by necessity, it was done.

Out of the revelations and experiences of the war came a great recognition and stimulus to the development of science which has resulted in the setting up by America, and several other nations, of new scientific organizations for the encouragement and support of scientific research and its applications by methods giving special attention to cooperative and coordinated work. Such methods involve an attempt to introduce a certain degree of organization into scientific investigation beyond that heretofore usually attempted.

The phrase, "organization of science," produces an unfavorable reaction from some scientific—and some non-scientific—men. It seems to suggest to them attempts to control scientific genius, to dominate scientific endeavor. They say that genius can not be organized, that scientific research must, like creative art, be left absolutely free from restraint. They ask if Galileo and Darwin and Einstein could have done greater things, or even the great things they have done, if they had been "organized." The implied answer is an emphatic No. And it may be accepted as the correct answer. But the question implies something that is not necessarily implied in the phrase "organization of science."

I know of no one in the National Research Council, nor do I believe there is any one in the new Department of Scientific and Industrial Research in England, or in the Bureau des Recherches in Paris, or in the National Research Council of Japan, who dreams of suggesting the advisability of organizing, or in any way interfering with, the individualistic work of scientific genius. What is suggested as advisable, because it was proved to be possible and highly effective in our wartime efforts, is to arrange for planned concerted attack on large scientific problems, especially such problems as require numerous cooperating workers and laboratories representing, often, not alone one special field nor even one major field or realm of science, but several such fields, as chemistry and physics, or chemistry and biology, or chemistry and physics and biology, or biology, geology and engineering, any one of which, and other, combinations, may be involved in the solution of large scientific problems affecting the national strength and welfare.

But even the isolated, individual workers may profit by the attention and encouragement and material support that may be given them by a coherent body of scientific men bringing to bear their collective influence to ameliorate the too often difficult conditions under which the isolated scientific investigator has to work, and to develop a wider appreciation, and hence public recognition and support, of scientific research.

What is the significance to the universities of this increased attention and new impetus

to research? And what is its significance to education and its methods? I suggest that this matter is so important that it requires a new and particular examination of the university and general educational situation as regards research and training for research.

The National Research Council has tried to become acquainted in some more exact degree than could be achieved by a perusal of college catalogues, or even an extended question and answer correspondence, with the present research situation in the colleges and universities of the country by means of a protracted series of personal visits by representatives of the council to some of these institutions. Up to the present one hundred and forty colleges and universities have been thus visited. This number includes enough institutions and institutions of enough variety to give us a fairly clear idea of the status of research and training for research in the colleges and universities of the land. Some day we may be inclined to publish a report or discussion of this situation as based on the information derived from these friendly visits.

But, for the moment, we may assume that we are all sufficiently informed in general of the state of our institutions of higher learning and the state of American higher education to warrant me in expressing certain opinions about the matter of research in the universities which your own knowledge will enable you to reject or confirm.

In the first place university research confronts a serious difficulty inherent in the very make-up and method of the peculiar American institution we call university. This institution *is* a university because it does university work. It isn't a university because it does much work that is not university work. To house under the same roofs, mix in the same laboratories, lecture- and class-rooms, and have sitting at the feet of the same instructors both preparatory and university students, is to produce an educational situation unique and very difficult—I should call it impossible—of successful carrying on. It is carried on, but not too successfully.

In the second place to give most of the attention, energy and money available to this curious institution to the preparatory students in it, because there are more of them than of the advanced students, is to place in secondary position the real university interest and members of this institution.

In the third place to give more attention and effort, as we really do, to the less capable, the uninterested, the non-attaining students than to the more capable, the interested and the attaining students, both in preparatory and university groups, is a menace to the highest usefulness of the institution if it is to exercise its true university function, which is the development of thinkers and leaders for the country. We may all be equal in our right to receive a common measure of service from the state but we are not all equal in our capacity to give service. The state, which is simply all of us, needs the benefit of the best use of our best brains, and to get it we must see that these best brains have the best of training.

In the fourth place to encourage the non-intellectual activities of the institution, such as its mere expansion in size, its display, its prowess in athletics, at the expense of its truly intellectual activities and achievements, is not grateful to the eyes of believers in the great need and importance to the nation of a university system of highest standard.

All these conditions, characteristic of the present American university, as I believe all you who know our universities intimately will admit, are serious difficulties in the way of the successful prosecution of research and training for research in these institutions. And this is true even when we construe research not in the narrow sense to which a growing technical and reverential use of the word tends to limit it, but in the most generous way in which it is entitled to be used, namely, simply as a going on in the quest for knowledge from that which is now known to that which is now unknown.

These conditions to which I have just referred are not only difficulties in the way of the development and achievement of research, and specific training for research, as such, but

they are difficulties in the way of the highest development of the whole intellectual atmosphere and achievement of America. The "Failure of the College" about which Professor Chapman, of Yale, writes so vigorously in a recent number of *School and Society,* is not simply the idle or sensational phrase of a sick pessimist but it is a phrase that well expresses the thoughts of almost all of us and that makes almost all of us feel sick as we face the facts. Yet we all go on; the colleges and universities all go on the usual way, as if the whole situation were out of our hands and on the lap of the gods for outcome. We act as if we were helpless; but that we should really admit that we are helpless is incredible. It is not American. It is not what we did when we faced the enormous problems of war. Do we have to have war to be capable? I am every day growing more impressed with the simplicity of war. War, which is supposed to bring complexity, brought us to simplicity and directness of thought and action; while peace, which should bring simplicity, has brought us to a perfect maze of complexity. No thing was too bold for us to attempt and achieve when we were at war. No thing seems capable of direct attack and solution now that we are at peace. But that is the sick pessimist again. And sick pessimism must not rule us. I am sure it will not. It is incredible that in this all-important matter of getting our higher education straightened out right we shall go on indefinitely acting as if we were helpless. Let the college or university that wishes to do the greatest thing just now to be done for higher education and true learning in America step forward and boldly do the unusual thing. Let it devote the most of its energies to the most important part of its work. It will soon not be alone in its doing. It will become a prophet with honor in its own land.

The National Research Council has recently interested itself in an inquiry as to what is being done to discover and encourage the students of superior capacity and attainment in the colleges and universities. One of its representatives has visited, since the first of February, about fifty institutions on this quest and for the purpose of friendly suggestion. He finds a lively appreciation of the importance of the matter, but a rather faint heart about doing anything about it.

In an interesting report recently made by this visiting representative, Professor George W. Stewart, of the University of Iowa, to the Council's Division of Educational Relations, certain impressions gained from his visits were expressed as follows:

Although each ambitious teacher is anxious to develop leadership, yet, on the whole, when judged by distribution of time his emphasis in fact is laid on helping the mediocre in ability and the deficient in attainment. At first consideration, a teacher is inclined to deny the accuracy of this statement, but the visitor has found that after a brief discussion there results a fairly unanimous assent to its truth. The individual encouragement of the student of ability is one of the delights of the professor, but his class-room efforts are of necessity gauged for the average and the presence of the passing mark attracts his attention automatically and constantly to those of low standing. In other words, the routine demands a constant interest in others than the most able.

None of the colleges visited is approximating its maximum service in the encouragement of superior attainment and in the detection and development of superior ability. The methods used by any institution have been adopted fortuitously rather than as a consequence of a definite sustained study of the problem. This is to be expected since the problem is really every one's business and concerted study and action is only given spasmodically when some one member has a single proposal that can be presented to the faculty in a form for action. This is not to be regarded as indicating a criticism of the professor but rather a weakness in our system.

Numerous colleges are utilizing mental tests in one way and another, but, because of the time and hence money required, such an activity is not as widespread as it should be. Obviously such tests would be helpful in detecting superior ability. The inactivity of other colleges in this matter can be accounted for by the fact that no individual has the time to devote to it and the administration or the faculty is not adequately informed concerning mental tests.

This matter of the utilization of mental tests in helping to discover the students of

superior capacity and hence possibility of superior attainment, involves a wider recognition than now exists of the positive use which modern psychologists are more and more making, in their development of the applications of psychological science, of the fact that not only are there such marked differences in native intellectual capacity or ability among persons as to permit the setting up, on a basis of intelligence tests, of such categories as idiot, feebleminded, sub-normal, average normal, superior and genius, but that within the group of so-called mentally normal human beings, which includes most college students, there still exist rather large differences in intellectual capacity. We all know this to be a fact, but few of us give it sufficient attention; few of us give it sufficient importance as an aid in guiding our practical activities. Now the value of the university's product is, as Terman well says, determined as much by the original quality of the raw material with which it works as it is by salary budget, instructional methods or curriculum. In an abundantly documented recent paper, this active exponent of modern psychology reveals the high significance which an analysis of the intellectual status of the student body of a university might have as a basis for positive action by any university determined to make the best use of its available resources for the advancement of American learning. He shows the positive economy in money, time and mental energy that could be effected by certain radical changes in university administration, and the highly desirable results which would come from these changes in the way of enabling the university to fulfil its highest function in the advancement of learning both through teaching and research. And only by such fulfilment can the nation make the most of its potential mental capacity.

I seem to have wandered somewhat from the particular subject which the title of my paper indicates to be especially mine this afternoon. But all of the things I have talked about have their definite relation to research in the universities. Yet one important phase of this subject I have alluded to by no more than a fortuitous juxtaposition of words. The relation between research and teaching is a subject which alone calls for another and longer paper than all of this present one, which ought to be inflicted on you some time by somebody. This is not the time nor am I the brutal body to do it. But I can not refrain from calling your attention, in my last moment with you, to the additional evidence of the curious and abnormal character of the institution we call university in America, which is afforded by the strange and highly injurious artificial opposition that has been created between research and teaching by the customs and methods of American higher education. Research and teaching are inseparable from, and indispensable to, each other in a real university. An institution which does radically separate or oppose them is not a university, however good and useful some other thing it may be. The University of Minnesota is a university because it is an institution which recognizes the intimate relationship and coincidence of teaching and research. And we may feel assured that under its new president it will continue, and with ever-increasing effectiveness, to fulfil its genuinely university function.

Vernon Kellogg
The National Research Council

THE METRIC SYSTEM IN JAPAN

The American Metric Association has received from the Decimal Association of London a brief statement by Dr. C. E. Guillaume, director of the International Bureau of Weights and Measures, relating to the progress of the metric system in the Far East. This was written on May 23, 1921, and we have had it translated for the information of the readers of Science. We have received from official Japanese sources additional information in regard to the Japanese metric law, passed on April 11, 1921, and the program for rendering it effective.

Practically all readers of Science will be glad to know that the Britten bill, now known as H. R. 10, is being endorsed by national organizations and has a fair chance of pass-

ing. Metric reports are being prepared by the United States Chamber of Commerce and the National Industrial Conference Board. The metric campaign is on in earnest and there should and will be no let up until success is won for North America.

The annual meeting of the American Metric Association for 1921 will be held in Toronto on December 29. In view of the inportance of the movement in America, we hope that a large number of the members of the A. A. A. S. will reserve December 29 for the program of the American Metric Association.

HOWARD RICHARDS, JR.,
Secretary, American Metric Association

The Obligatory Adoption of the Metric System by the Empire of Japan

A telegram from Mr. Shirio Kikkawa, Director of the Bureau of Weights and Measures in Tokio, brings the news of the passage by the Japanese Parliament of the law rendering the employment of the metric system obligatory. The importance of this event, significant in itself, becomes greater in view of the fact that this settles the supremacy of the metric system in the Far East and also practically in the whole world. In Asia, legislative acts have, during the past few years, paved the way for a greater use of metric units and the governments are now making these acts effective. The work is pushed systematically in such a way as to assure gradual expansion, thus avoiding mistakes and inconveniences.

In Japan the metric system became legal on January 1, 1893, and at the same time the value of the old Japanese units, the shaku and the kwan, were fixed respectively at 10/33 of the meter and at 15/4 of the kilogram. The divisions of these Japanese units were also decimal. Subsequently a series of modifications of this law, and the promulgation of regulations, assured the increased use of the metric measures leading up to the time when their use should become obligatory.

In China the law of August 29, 1908, has given definite values to units which until then were variable according to the localities and the trades. The ch'ih and the liang have been fixed respectively as 32 centimeters and 37.301 grams. The metric equivalents are inscribed in the law; and the subdivisions of these Chinese units are also entirely decimal.

The law approved in 1913 by the Parliament of Pekin prepares for the complete and obligatory adoption of the metric system; a program of preparation and partial adoption is annexed to this law and leads, after ten years, to the obligatory use of the metric system.

Finally, in Siam, a law of 1912 prescribes the obligatory use of the metric system with gradual expansion from one province to another depending on the time required to secure a sufficient number of measuring devices and metric standards.

As can be seen from the preceding paragraphs, in all the Far East, the definite adoption of the metric system is decided in principle; delays in securing the general use of the metric system in the Far East can now only postpone it for a few years.

On the other hand, the House of Representatives of the United States has before it a bill dated April 11, 1921, introduced by Congressman Britten, which will render the use of the metric system obligatory for commercial transactions 10 years after its passage. It is well to note that the adversaries of the reform have heretofore considered it a good argument that the Anglo-Saxon measures were received in China, Japan, and Siam, having almost the same standing as the local measures. The promulgation of the new Japanese law reverses the sense of that argument.

C. E. GUILLAUME

SCIENTIFIC EVENTS

THE PARIS ACADEMY OF SCIENCES

THE *Annuaire* of the Académie des Sciences for 1921 gives as usual a complete list of the members, as well as of the foreign associate members, the correspondents and the "académiciens libres." The annual also gives, as it always does, the names and dates of the successive presidents from the foundation of the Académie des Sciences, as the First Class of the newly organized Institut, on December 27, 1795, to the present time. At the close is an alphabetical "Index Biographique" of all the members and correspondents from 1795 until 1921. This covers nearly 200 pages (pp. 117–314). It mentions a complete list of all the prizes founded by or for the Académie.

The necrology of the Académie for 1920, includes the following members:

M. Armand Gautier, of the Section of Chemis-

try, died at Cannes, July 27, 1920, in his eighty-third year.

M. Jean Jacques Théophile Schloesing, of the Section of Rural Economy, died at Paris, February 8, 1919, in his ninety-fifth year.

M. Yves Delage, of the Section of Anatomy and Zoology, died at Sceaux (dept. Seine) October 7, 1920, at the age of sixty-six years.

M. Adolphe Carnot, Académicien Libre, died June 21, 1920, in his eighty-first year. It is after him that the great radium source, carnotite, has been named.

Of the Foreign Associate Members, the death is announced, in Berlin, of

Simon Schwendener, of Buchs, canton of St. Gall, Switzerland. He was born February 10, 1829, and at the time of his death, May 27, 1920, he was in his ninety-first year.

The following new members were chosen in 1920:

Augustin Mesnager, Section of Mechanics, elected March 1, 1920. Born in Paris June 11, 1862.

Léon Lindet, Rural Economy, chosen March 15, 1920. Born in Paris April 10, 1857.

Maxime Laubeuf, Section of Industry, elected March 22, 1920. Born at Poissy (dept. Seine-et-Oise) November 23, 1864.

Jules Louis Breton, Académicien Libre, elected November 29, 1920. Born at Courrières (dept. Pas-de-Calais) April 1, 1872.

G. F. K.

THE IOWA LAKE SIDE LABORATORY

TRUSTEES for the Iowa Lake Side Laboratory at Lake Okoboji are to acquire a majority interest in the holdings of the stock company which now owns the property. A reorganization of the business control is to be effected, and owners of stock will be solicited to surrender their shares to the trustees in order that the work of the laboratory may be carried on in the best manner possible.

A committee from the University of Iowa Association has been authorized to secure funds for the repairing and general upkeep of the laboratory premises, and an endowment fund of $10,000 will be sought for this purpose. Mrs. F. A. Stromsten, of Iowa City, is chairman of the committee, the other members being A. J. Cox and Mrs. Preston C. Coast, of Iowa City; Dr. F. J. Smith, of Milford; and Fred Pownall, of Des Moines.

President Emeritus Thomas H. Macbride, who has been most active in the interests of the laboratory ever since it was established, has resigned his position on the board of trustees. Dr. Macbride has carried practically the entire burden of responsibility for the financial support of the institution, which has attained enviable distinction in recent years through the quality of work done there and the facilities and resource of material which it affords. His place on the board will be taken by Walter M. Davis, of Iowa City, who becomes custodian of property. Mrs. F. A. Stromsten, of Iowa City, was elected to succeed Euclid Sanders, of Iowa City, who has been in Europe for some time. W. O. Finkbine, of Des Moines, remains as chairman of the board, the other two members being C. F. Kuehnle, of Denison, and J. J. McConnell, of Cedar Rapids.

JENNINGS ANNIVERSARY CELEBRATION

AT the Harvard Commencement of 1896 Herbert Spencer Jennings, now Henry Walters Professor of Zoology in the Johns Hopkins University, received the Ph.D. in zoology. During the present year his students, teachers, colleagues, and friends have joined in a recognition of the twenty-fifth anniversary of his doctorate. A committee consisting of S. O. Mast, chairman, R. W. Hegner, Raymond Pearl, and Ruth Stocking Lynch, secretary, had charge of the arrangements.

The number of contributors was 135, geographically distributed as follows: Baltimore 31, Washington 9, Philadelphia 9, Northeast 25, South 8, Middle West 14, Far West 27, Canada 1, Germany 5, Holland 1, Switzerland 1, Japan 1, Philippines 2, Hawaii 1.

A sufficient sum of money was subscribed to carry through the following projects:

1. A portrait of Professor Jennings, painted by the well-known Philadelphia artist, Mr. Frank B. A. Linton. This portrait was presented to the trustees of the Johns Hopkins University by Professor A. O. Lovejoy at the Commencement exercises this year, and hung

in Gilman Hall, as a permanent memorial of the occasion.

2. An anniversary volume, made up of congratulatory letters to Professor Jennings, together with photographs of the writers, to the end that he personally may have a permanent reminder of the affection and esteem in which he is held by his old students and colleagues. This volume in quarto format is bound in full crushed levant morocco, and contains a large number of letters from all parts of the world.

3. A large silver platter presented to Mrs. Jennings, as a token of the part she has played in her husband's scientific career, and in the lives of his students during their university days.

4. Photographic copies of the portrait, one of which is to be sent to each contributor to the celebration.

On May 28 a subscription dinner was given in Professor Jennings's honor at the Chateau in Baltimore. Some 44 persons were in attendance. Dr. C. B. Davenport presented a remarkably impressive review of Jennings's scientific career and contributions to biology. The anniversary volume was presented. In replying Professor Jennings gave an analysis, at once penetrating and humorous, of the manifold advantages of maturity over youth.

SCIENTIFIC NOTES AND NEWS

Dr. Alexis Carrel, member of the Rockefeller Institute for Medical Research, has been elected a national associate of the Paris Academy of Medicine. Under the rules of the academy there may be only twenty national associates, all of whom have heretofore been residents of France.

Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, has received the honorary degree of doctor of science from Brown University, as well as from Yale University. Dr. Oswald T. Avery, of the institute, received the honorary degree of doctor of science from Colgate University.

The University of Pennsylvania has conferred the degree of Doctor of Laws on Dr. Hobart Amory Hare, professor of materia medica in Jefferson Medical College.

Bowdoin College has conferred the degree of Doctor of Science on Dr. Preston Kyes, professor of preventive medicine in the University of Chicago.

The degree of Doctor of Science has been conferred by Tufts College on Frank William Durkee, professor of chemistry at the college, and on William Henry Nichols, chairman of the Allied Chemical and Dye Corporation.

Honorary degrees of Doctor of Science were conferred on June 15 by Colorado College on Professor S. L. Goodale, professor of metallurgy at the University of Pittsburgh, and on Dr. C. A. Hedblom, of the Mayo Foundation. Both are alumni of the Colorado College.

Dr. John A. Kolmer, professor of pathology and bacteriology in the graduate school of medicine of the University of Pennsylvania, and director of the pathologic laboratories of the Dermatological Research Institute, received the honorary degree of Doctor of Science at Villanova College.

The University of Manchester has conferred the degree of D.Sc. on Dr. C. S. Sherrington, professor of physiology, Oxford, and president of the Royal Society; on Dr. Horace Lamb, formerly Beyer professor of mathematics in the university; and on Sir Ernest Rutherford, formerly professor of physics. The degree of Litt.D. has been conferred on Dr. G. Elliot Smith, formerly professor of anatomy.

According to *Nature* the list of honors conferred on the occasion of the King's birthday includes the following names of men known to the world of science: *Knights:* Professor Arthur Keith, Hunterian professor and conservator of the Royal College of Surgeons; Dr. T. Lewis, hon. consulting physician since April, 1918, to the Ministry of Pensions; Dr. S. Russell-Wells, vice-chancellor of the University of London; Dr. F. Conway Dwyer, ex-president of the College of Surgeons, Ireland; Mr. J. B. Harrison, director and govern-

ment analyst, Department of Science and Agriculture, British Guiana; and Brig.-Gen. D. J. McGavin, director-general of Medical Services in New Zealand. *C.B.:* Mr. Ll. S. Lloyd, assistant secretary to the Department of Scientific and Industrial Research. *K.C.I.E.:* Col. W. H. Willcox, late medical adviser to the Civil Administration in Mesopotamia. *C.I.E.:* Dr. M. N. Banerjee, principal of Carmichael Medical College, Belgatchia, Bengal. *Companion Imperial Service Order:* Mr. G. J. Williams, senior inspector of mines, Mines Department.

PROFESSOR G. F. FERRIS, of Leland Stanford University, California, is spending the summer collecting and studying scale insects in Texas, in cooperation with the Division of Entomology of the Texas Agricultural Experiment Station.

THE British government will devote the sum of 1,000,000*l.* to fostering cotton-growing in the Empire. The money will be placed at the disposal of the British Empire Cotton Growing Corporation, and will be in place of the government's former promise of 50,000*l.* a year for five years to the corporation.

UNIVERSITY AND EDUCATIONAL NEWS

DR. LIVINGSTON FARRAND, chairman of the executive committee of the Red Cross, formerly adjunct professor of psychology and professor of anthropology at Columbia University and president of the University of Colorado, has been elected president of Cornell University.

DR. FRANK PIERREPONT GRAVES, dean of the school of education of the University of Pennsylvania, has been appointed commissioner of education of the state of New York and president of the University of the State of New York.

DR. P. J. HANZLIK, of the medical school of Western Reserve University, has been appointed professor of pharmacology in the Stanford University Medical School to succeed Professor A. C. Crawford, who died recently.

DR. W. H. RODEBUSH, who has been for the past year a research fellow of the National Research Council at the University of California, has been appointed associate professor of physical chemistry at the University of Illinois.

GEORGE M. WHEELER, PH.D. (1921), Bussey Institution, has been appointed instructor in entomology, and William E. Greenleaf, instructor in zoology, in the zoology department of Syracuse University.

DR. R. R. GATES has been appointed to the university chair of botany tenable at King's College, University of London, in succession to Professor W. B. Bottomley. He was appointed university reader in botany at that college in 1919, and has since that date been in charge of the department in the absence of Professor Bottomley.

DISCUSSION AND CORRESPONDENCE

THE CANNONBALL LANCE FORMATION

TO THE EDITOR OF SCIENCE: In reviewing Stanton's memoir on the Cannonball Lance formation, Dr. Schuchert has advocated drawing the line between Cretaceous and Tertiary at the base of the Wasatch. He has referred to the vertebrate evidence as supporting this view, and as recent researches have considerably clarified and extended this evidence, a brief summary of its present status may be of some aid toward harmonizing the existing conflict of opinion.

The position of these border-line formations has been in dispute not merely for a number of years, as Dr. Knowlton remarks, but ever since they were first discovered. A Cretaceous vertebrate fauna was found associated with a Tertiary flora. Vertebrate palæontologists and palæobotanists took opposite sides; the stratigraphic geologists were divided, and the relations with the marine succession, European standard, theories of diastrophism, etc., have been invoked by both sides for a decision. This discrepancy has been maintained and confirmed by all subsequent work. It should be recognized as the fundamental difficulty. It does not help matters to misrepresent or ignore any part of the evidence, and if Dr. Cross's references to the vertebrate evidence fairly reflect the way in which the U.

S. Geological Survey "considered all available evidence" it is clear that its weight and tenor was not correctly understood.

When the subject was discussed by the Palæontological Society in 1913 I presented a paper outlining the vertebrate evidence, especially with regard to the Paleocene faunas.[1] Subsequent researches by Brown, Lambe, Osborn and Parks on the Alberta dinosaurs, by Gilmore on the New Mexican reptiles, by Granger and myself on Paleocene and Eocene mammals, by Stehlin, Teilhard and Schlosser on the Eocene and Paleocene mammals of Europe, by Smith Woodward and myself on the Cretaceous mammals of Alberta, confirm the correlations and conclusions presented in that paper, but strengthen certain views which were then rather suggested than advocated.

1. The Lance fauna is wholly Cretaceous in character. It is entirely a continuation and specialization of the Judith (late Cretaceous) without any new elements, but the amount of evolutionary change in the many phyla that have now been traced through Judith, Edmonton and Lance shows that it is considerably later in time.

2. The earliest placental mammals appear in the Puerco "Lower Paleocene" which may be as old as the Lance or older, although usually regarded as later. The Torrejon and Fort Union faunas, Upper Paleocene, are not much later than the Lance, and the phyletic evolution indicates that they are considerably later than the Puerco. The Tiffany and Cernaysian faunas show a still later stage of the Paleocene faunas.

3. The Paleocene placentals are of primitive and archaic aspect. Although some of their phyla survive into the Eocene, they are as a whole not nearly related to the characteristic and dominant Tertiary Mammalia, and much more primitive. The metatherian mammals (multituberculates and marsupials), a minor but considerable element in the Paleocene faunas, are of distinctly Mesozoic aspect and closely related to those of the Judith and Lance. The reptiles are all Cretaceous families continued from the Judith.

[1] *Bull. Geol. Soc. Am.*, XXV., pp. 381–402 Sept. 15, 1914.

4. The true Tertiary mammal fauna appears suddenly at or near the base of the Wasatch, and in the Sparnacian of Europe (London Clay, etc.). It is a new fauna, identical in these two far distant regions, and consists in the main of the modern orders of mammals, which now appear for the first time and evolve through the course of the Tertiary into their present diversity and specialization. The two most important families of Tertiary and modern chelonians (terrapins and tortoises) appear at the same time.

5. The great faunal break lies at the end of the Paleocene, with the incoming of the Cenozoic vertebrates at or near the base of the Wasatch. The European standard has drawn the line above the great chalk formations and below the Thanetian (Cernaysian). The Judith corresponds to the Upper Senonian of Europe, but is older than the Maestrichtian and Danian divisions of the chalk, unquestionably Cretaceous, aside from certain formations of disputed age grouped as Montien. The end of the unquestioned Cretaceous in Western Europe is then considerably later than the Judith, perhaps as late as the Lance or later. Its precise correlation can best be made through comparisons of the marine Cannonball phase of the Lance formation with the Danian, etc. On the other hand the Tertiary as generally recognized in Western Europe begins at least with the Thanetian, containing the Cernaysian fauna, uppermost Paleocene, equivalent to the Tiffany zone at the base of the Wasatch in the San Juan basin. It is therefore a little below the great migrational break indicated by the vertebrate faunas.

There are two criteria generally used in faunal classifications, the extinction of ancient types and the first appearance of new groups. The latter appears to me the more logical and practical. By this standard the Wasatch Sparnacian fauna of the London Clay, etc., is the introduction of the distinctively modern or Cenozoic life, the preceding faunas, even including the Paleocene placentals, being essentially the last stages of Mesozoic life.

This division is not supported by the palæobotanists. Their Cenophytic era, it is well recognized, begins with the upper Cretaceous

(Dakota, etc.); they find a sharp floral break between Judith and Lance at a point where no break occurs in the vertebrate fauna; and so far as I understand no serious break between Paleocene and Eocene. I can hardly venture an opinion as to where the majority of invertebrate palæontologists would draw the line, if based wholly on invertebrate data; in practise most of them draw it at the summit of the chalk succession of western Europe.

The great stratigraphic break asserted by some stratigraphers to exist everywhere at the base of the Tertiary is denied by others of no less ability and experience, and its universality and importance seem to have been much exaggerated.

Is it not possible, where the evidence is thus conflicting, to adopt a compromise by mutual concession? It appears to me that the compromise indicated by Schuchert has the best elements for universal acceptance. It is in accord with the historic and universal European usage, including the Thanetian in the Tertiary, but none of the chalk succession. It conforms to the insistence of the palæobotanists that the Lance and Fort Union should be kept together. It gives a satisfactory practical base for the stratigrapher in the widespread and characteristic Wasatch formations. It places all the dinosaur formations and the bulk of the "Paleocene" faunas in the Cretaceous where the former certainly and the latter in my opinion properly belong; but the uppermost Paleocene faunas are placed in the Tertiary. The replacement of the Cretaceous by the Tertiary vertebrate fauna would thus be a little later, of the Upper Cretaceous by the Tertiary flora a little earlier than the line agreed upon.

W. D. MATTHEW

NEWCOMB ON EXTRA-MUNDANE LIFE

TO THE EDITOR OF SCIENCE: As one long interested in the subject matter covered by the inquiry of Professor Clark, published in SCIENCE of May 13, I have read with some care Newcomb's essay to which Professor Campbell refers, in the same issue of SCIENCE. While this essay may be presumed to represent an opinion at some time entertained by its distinguished author, an opinion that merits respect, it seems wholly unresponsive to the request for evidence upon which such an opinion may be based. The author expressly admits that "scientifically we have no light upon the question and therefore no positive grounds for reaching a conclusion." In another place, *Popular Astronomy,* ed. 1890, p. 528, he amplifies as follows:

> The spirit of modern science is wholly adverse to speculation on questions for the solution of which no scientific evidence is attainable, and the common answer of astronomers to all questions respecting life in other worlds would be that they knew no more on the subject than any one else and having no data to reason from, had not even an opinion to express.

It is probable that few astronomers will dissent from either of these statements. Most of them, Newcomb included, will concur in the statement that of the hundred or more millions of celestial bodies known to exist it may be shown with a high degree of probability that, barring our two neighbors, Mars and Venus, no one of them is suited to be the abode of animate beings. As to the numerous worlds alleged to be the abode of life, Newcomb in his essay raises the question: "But where are we to look for these worlds?" and replies to it: "This no man can tell." Nevertheless, as quoted by Professor Campbell, he goes on to say:

> It is perfectly reasonable to suppose that beings not only animated but endowed with reason inhabit countless worlds in space.

A major premise upon which this conclusion might rest would seem to be: We may reasonably suppose anything that does not admit of disproof. In the bald form here stated this premise would doubtless be rejected by those who believe in the plurality of abodes for animate intelligence, but without some appropriate equivalent for it there seems to be a hiatus between the conclusion above set forth and the facts that constitute its minor premise. Possibly Newcomb's own words anent this subject matter, *loc. cit.*, p. 531, may be a less objectionable formula:

Here we may give free rein to our imagination with the moral certainty that science will supply nothing tending either to prove or to disprove any of its fancies.

In this connection one is reminded of a famous apothegm,

Faith is the substance of things hoped for, the evidence of things not seen.

George C. Comstock

QUOTATIONS

COOPERATIVE INDEXING OF SCIENTIFIC LITERATURE

We have shown that the core or *umbra* of a subject is comprised in a body of homogeneous literature which unquestionably can best be dealt with by its representative professional society, but that outside this core there exists a *penumbra* of relevant matter dispersed through a literature of gradually increasing irrelevance, with the result that the recovery of the relevant matter can be effected economically only by cooperative effort. The solution, therefore, would appear to be to bring into existence a central bureau which should deal solely with the indexing of periodicals of the non-homogeneous character—and in the first stages of its work, with a restricted list of periodicals assigned to it by the contributory bodies. These bodies would receive from the central bureau entries from the periodicals examined corresponding to their specified requirements. But as the professional abstracts became more fully representative of progress in their respective fields the need for the publication of the corresponding indexes would tend to disappear. The institution, therefore, of a central bureau would ultimately make for economy in all branches of science in which the publication of abstracts is admittedly indispensable.

So far as science is concerned, it will probably be found that the simplest and most effective method for obtaining the necessary index slips would be to invite the Central Bureau of the "International Catalogue of Scientific Literature" to provide them. Indeed, the possibility of cooperation between the "International Catalogue" and the abstracting journals was one of the subjects considered at the conference held last September. Any such arrangement would probably begin with the year 1921, and, as a preliminary, the "International Catalogue" should be brought up to date by the publication of volumes for 1915–20.—*Nature.*

SPECIAL ARTICLES

THE MOTIONS OF THE PLANETS AND THE RELATIVITY THEORY

Constant reference is made to the motion of Mercury about the sun and to the supposed fact that this motion can not be explained by the Newtonian law of gravitation. This current idea is far from correct: the motion of Mercury can be accounted for fully as well, if not far better, by the Newtonian law than by the Einstein law. The difficulty, which has faced mathematical astronomers for many years, is not how to account for the motion of Mercury, but how to account for that motion without introducing complications in the motions of the other planets.

In 1895 Newcomb[1] showed clearly that the motion of Mercury can be fully accounted for, under the Newtonian law, by one of several possible distributions of matter in the immediate vicinity of the sun and the inner planets. He, however, discarded each such possible explanation of the motion of Mercury because of the difficulties encountered in explaining, at the same time, the motions of the other planets. Each possible explanation of the motion of Mercury introduced a new complication somewhere else in the system.

Now identically the same difficulty is encountered by Einstein. His formulas account for the motion of Mercury, but fail to account for the motion of Mars, and introduce a further complication in the motion of Venus. The supposed explanation of the motion of Mercury by the Einstein formulas has been stressed, but the attendant difficulties in the motions of the other planets have been glossed

[1] "The elements of the four inner planets and the fundamental constants of astronomy," by Simon Newcomb.

TABLE I

Secular Motions of the Elements of the Four Inner Planets

	Observed	Computed	Difference	Per Cent.
Perihelia:				
Mercury	+ 579.2″	+ 537.6″	+41.6″ ± 1.4″	+ 7.2%
Venus	+ 42.4	+ 49.7	− 7.3 ±22.3	−17.2
Earth	+1161.5	+1155.6	+ 5.9 ± 5.6	+ 0.5
Mars	+1605.9	+1597.8	+ 8.1 ± 2.6	+ 0.5
Inclinations:				
Mercury	+ 7.14″	+ 6.76″	+ 0.38″± 0.54″	+ 5.3%
Venus	+ 3.87	+ 3.49	+ 0.38 ± 0.22	+ 9.8
Mars	− 2.26	− 2.25	− 0.01 ± 0.14	− 0.4
Nodes:				
Mercury	− 753.0″	− 758.1″	+ 5.1″ ± 2.8″	+ 6.8%
Venus	−1780.7	−1790.9	+10.2 ± 2.0	+ 0.6
Mars	−2248.9	−2249.8	+ 0.9 ± 4.6	+ 0.0

over by those who accept the relativity theory as proved.

In order to understand fully this question of the motion of Mercury and the difficulties of finding a satisfactory explanation, reference should be had to the secular motions of the elements of the planets, as determined by Newcomb. These motions are given in Table I.

The first column in the above table gives the actual motions in one century as determined from observations of the actual planets; the second column gives the corresponding motions as calculated by the formulas of celestial mechanics, deduced from the Newtonian law of gravitation. It is, however, well known to every mathematical astronomer that these calculations are not complete; that they do not take fully and completely into account all of the bodies of the solar system. In the theories and formulas upon which these calculations depend, the sun has been considered as a perfect sphere and all space between the sun and the various planets as free from all gravitational matter. These are necessary mathematical simplifications; without them the equations of motion would be impossible of solution. These simplifications approximate very closely to the truth and the results obtained by their use very closely represent the motions of the planets, but they are *approximations* and it, therefore, necessarily follows that the results do not accurately represent the actual motions.

The column of differences contains the unexplained portions of the motions of the planets, together with the "probable error" as determined by Newcomb. That is, in one century the perihelion of Mercury moves 41.6″ of arc more than the *approximate calculations* indicate it should; whilst that of Venus does not move quite as swiftly as these computations would lead one to expect. These unexplained portions of the motions are the so-called "discordances" or "discrepancies." That of the perihelion of Mercury is especially well known and has figured prominently in all attempts to prove false the law of Newton. The perihelia of Venus and Mars show large discrepancies, as do also the nodes of both Mercury and Venus.

The probable errors give some idea as to the relative accuracy of the various determinations, but it must be remembered that the assignment of these probable errors is very largely a matter of judgment, and that these values may have been over- or underestimated. In every step of the long and complicated computations an estimate, rather than an exact calculation, has to be made as to the value of the probable error, and the final value, as given in the table, thus depends upon many separate estimations or judgments.

It is known to every astronomer that the assumptions, upon which are based the simplifications used in the calculations, are not true. Neither the sun nor any one of the planets is a perfect sphere. The sun-spots, which

can be seen with an ordinary small telescope, show that the sun is not of uniform shape and density. While exact measurements of the shape of the sun are extremely difficult to make, yet every series of measures, heretofore made, show distinct departure from a true spherical form. The sun is not a sphere.

Passing outward from the sun itself one finds the corona. At times of eclipse this halo, or brilliant crown, about the sun can be seen by the unaided eye. It has been sketched many times; it has been photographed times without number. Its presence proves the sun to be surrounded by an envelope of matter of irregular shape and of vast size. This envelope is in general lens-shaped and it extends far out beyound the orbit of the earth. On clear dark nights the extreme outer portions of it can be seen after sunset as a faint glow in the western sky,—a glow that is well known under the name of the zodiacal light.

While matter is thus known to exist in the vicinity of the sun and the inner planets, yet its effect upon the motions of these planets cannot be accurately calculated. Until its distribution is fully known, its effect can not be reduced to figures. It is perfectly clear that the figure, 537.6″ per century, does not accurately represent the motion of Mercury's perihelion under the Newtonian law; but, in the present state of our knowledge as to the solar envelope, it is impossible to correct definitely this figure and to state finally what the true figure should be.

The whole question of the effect of this matter upon the motions of the planets has been made the subject of several recent investigations, notably by Jeffreys and Seeliger.[2] As the actual distribution of this matter is unknown, the problem is attacked in reverse: that is, from the discordances is found a general distribution of matter, which will account for the motions, and this calculated distribution is then compared with the known facts. This procedure is analogous to the method by which the planet Neptune was discovered.

The matter in the immediate vicinity of the sun would tend to group itself about a plane somewhere near that of the solar equator, or that of the orbit of Mercury; whilst matter at a considerable distance from the sun would tend more towards the invariable plane of the planetary system, which is nearly the same as that of the orbit of Jupiter. Further the density of the matter will decrease as the distance from the sun increases. This general distribution can be approximated to by assuming the whole mass to be made up of ellipsoids of revolution, each ellipsoid to be of uniform density, but the larger ones to be of much less density than the inner ones.

An ellipsoid, or ring, of matter wholly within the orbit of a planet will give a direct motion to the perihelion. But if the orbit actually lies in the matter composing such ellipsoid, then the effect is the opposite and the motion of the perihelion will be retrograde. This, of course, upon the assumption that the density is uniform throughout; if the density is much greater in the central portions of the ellipsoid, then the retrograde effect of the outer portion may be overcome and the total effect upon the perihelion may be direct, but the motion will be less than that due to the central portion alone. By adjusting the rate at which the density is assumed to decrease, any motion of the perihelion, direct or retrograde, within limits can be obtained. To changes in the density of the envelope surrounding the sun may thus be attributed the discordant motions of the perihelia of the four inner planets, and especially the retrograde discrepancy in the motion of Venus.

The entire mass of matter, which is known to exist, may for the purposes of computation be considered as made up of three ellipsoids, or as showing two abrupt changes in density. The small central dense portion lies wholly within the orbit of Mercury, the intermediate portion wholly within the orbit of the earth,

[2] "The secular perturbations of the four inner planets," by Harold Jeffreys, *Month. Notices, R. A. S.*, Vol. LXXVII., p. 112.

"Das Zodiakallicht und die emperischen glieder in der bewegung der planaten," by Seeliger.

De sitter, *Observatory*, Vol. XXXVI., 1913.

TABLE II

Final Discordances in the Secular Motions of the Elements of the Four Inner Planets

	Amounts to Account for Newcomb	Amounts Accounted for by			Final Discordances	
		Einstein	Seeliger	Poor	Einstein	Poor
PERIHELIA:						
Mercury	+41.6″	+42.9″	+41.7″	+41.6″	− 1.3″	+0.9″
Venus	− 7.3	+ 8.6	+ 7.3	− 7.5	−15.9	+0.2
Earth	+ 5.9	+ 3.8	+ 4.1	+ 5.9	+ 2.1	+ 0
Mars	+ 8.1	+ 1.3	+ 6.4	+ 6.9	+ 6.8	+1.2
INCLINATIONS:						
Mercury	+ 0.38″	0	0	+ 0.37″	+ 0.38″	+0.01″
Venus	+ 0.38	0	0	+ 0.45	+ 0.38	−0.07
Mars	− 0.01	0	0	+ 0.12	− 0.01	−0.13
NODES:						
Mercury	+ 5.1″	0	+ 5.4″	+ 4.9″	+ 5.1″	+0.2″
Venus	+10.2	0	+10.0	+ 9.1	+10.2	+1.1
Mars	+ 0.9	0	+ 7.2	+ 4.3	+ 0.9	−3.4

and the outer, or less dense, portion extends beyond the orbit of the earth nearly to that of Mars. The effect of each ellipsoid upon the perihelia, the nodes, and the inclinations of the planets can be found by simple formulas of celestial mechanics, and the positions and densities of those ellipsoids, which will best account for all the motions, can be determined. No distribution can be found that will rigorously satisfy all the motions, but the positions and densities of three ellipsoids can be found which will approximately satisfy all the equations and practically account for all the discordances in the motions of the planets.

The table given above shows with what a high degree of accuracy the motions of the planets can be accounted for under the action of this widely scattered matter. For purposes of comparison the Einstein motion is also given.

The relative probabilities of two theories, or two solutions of a problem, are usually determined from the final differences, or residuals, as these differences are called. That solution is deemed the more probable which makes the sum of the squares of the residuals the smaller. If this test be applied to the residuals as given in the above table, the results are:

Einstein theory	436
Solar envelope, Seeliger	259
Solar envelope, Poor	14

And these clearly indicate how very much more probable is the explanation of the motions of the planets as due to the presence of matter in space, than as due to the hypotheses of Einstein.

Einstein and his followers have cited the motions of the planets as proof of the truth of his hypotheses. The evidence does not sustain this—his hypotheses and formulas are neither *sufficient* nor *necessary* to explain the discordances in these motions. They are not *sufficient,* for they account for only one among the numerous discordances—that of the perihelion of Mercury; they are not *necessary* for all the discordances, including that of Mercury, can readily be accounted for by the action, under the Newtonian law, of matter known to be in the immediate vicinity of the sun and the planets.

It is, however, possible that the Einstein hypotheses be true, and that the discordant motions of the planets result from a combination of the Einstein motions and the effect of the widely distributed matter in space. Just as a definite distribution of matter can be found which will explain the discordances given by Newcomb, so also another and different distribution can be found that will more or less fully account for the discordances remaining after applying the Einstein effects. But it is clear that the relativity theory alone is not *sufficient* to explain the motions of the planets.

Thus the motions of the planets do not prove the *truth* of the Einstein theory, nor, on the other hand, do they prove its *falsity*. While these motions can be accounted for by a certain distribution of matter in the solar envelope, it has not yet been established by observation that the matter is actually distributed through space in the required way. The presence of the matter is unquestioned; its distribution is still a problem of observational astronomy. In the present state of our knowledge regarding the distribution of this matter throughout space, the motions of the planets do not and can not furnish a definite answer to the question as to the validity of the Einstein hypotheses of relativity.

CHARLES LANE POOR

COLUMBIA UNIVERSITY,
April, 1921

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF ORGANIC CHEMISTRY

Rodger Adams, *chairman*
H. T. Clarke, *secretary*

Arsenated benzophenone and its derivatives: W. LEE LEWIS and H. C. CHEETHAM. Benzarsonic acid is best prepared by reduction of p-nitrobenzoic and arsenation by means of Bart's reaction. With phosphorus trichloride and pentachloride, dichloro-p-arsinobenzoyl-chloride results. By means of the Friedel and Crafts reaction, benzophenone-p-arsenious oxide, arsenious acid, and arsonic acid are formed. The similar derivatives of 4-methyl benzophenone-p-arsenious oxide, 4-methoxy benzophenone-p-arsenious oxide, and 4-phenoxybenzophenone-p-arsenious oxide have been prepared. Their nitro compounds, oximes, and isomers are being studied. With arsanilic acid, dichloro-p-arsinobenzoylchloride gives the di-arsenated benzanilide. The further reactions of dichloro-p-arsinobenzoylchloride with hydrocarbons, ethers, phenols, and various amino- and hydroxy-compounds are being studied.

6 chlorophenalphanapthazarsine and some of its derivatives: W. LEE LEWIS and C. S. HAMILTON. 6 chlorophenalphanapthazarsine is prepared by heating phenyl alpha naphthylamine with arsenic trichloride. 6 cholorophenalphanapthazarsine with hydrogen peroxide gives phenalphanapthazarsinic acid. The sodium salt of this acid has been prepared. A series of compounds, 6 methoxyphenalphanapthazarsine, 6 ethoxyphenalphanapthazarsine, 6 propoxyphenalphanapthazarsine, 6 butoxyphenalphanapthazarsine, 6 phenoxyphenalphanapthazarsine are prepared by treating 6 chlorophenalphanapthazarsine dissolved in xylene with the corresponding sodium alcoholate. 6 bromophenalphanapthazarsine is prepared by refluxing 6 phenalphanapthazarsine oxide or 6 phenoxyphenalphanapthazarsine with hydrobromic acid. 6 phenalphanapthazarsine oxide is prepared from 6 chlorophenalphanapthazarsine by heating with silver oxide.

Condensation reactions with benzyl cyanide: FRED W. UPSON and T. J. THOMPSON. Several phenyl alkyl succinic nitrils have been made by condensing benzyl cyanide either (1) with the cyanhydrine of the aliphatic aldehyde in the presence of sodium methylate, or (2) with the α brom ester of the fatty acid in the presence of sod-amide in ether suspension. Saponification of the resulting condensation products has given substituted succinic acids. The following have been made by method No. 2: methyl phenyl succinic acid, m.p. 185°; ethyl phenyl succinic acid, m.p. 194°; N. propyl phenyl succinic acid, m.p. 214°; and the following have been made by both methods: Iso-propyl phenyl succinic acid, m.p. 178°; iso-butyl phenyl succinic acid, m.p. 186°. The nitrils of the higher members can be saponified only under pressure. Some evidence has been obtained for the formula $C_6H_5—\overset{H}{C}=C=N—Na$ for the sodium salt of benzyl cyanide.

Derivatives of trihalogen tertiary-butyl alcohols. IV. The benzoic acid ester of tribromo-tertiary butyl alcohol or brometone benzoic acid ester: T. B. ALDRICH. The benzoyl ester of tribromo tertiary-butyl alcohol, $C_6H_5CO.OC—C_3H_6Br_3$, is prepared most conveniently by mixing molecular quantities of benzoyl chloride and preferably anhydrous tri-bromo tertiary butyl alcohol and heating on the steam bath until hydrogen bromide ceases to be given off. The ester is purified by heating on the steam bath with 5–10 per cent. caustic soda solution, washing with water, and finally recrystallizing from alcohol. It crystallizes in the monoclinic system and melts at 89–90°. It is readily soluble in the organic solvents, but insoluble in water. It is not so readily saponified as the aliphatic esters of either chloretone or bromotone. It is practically non-volatile at either incubator or room temperature, and is not volatile with steam to any extent. In general its properties are the same as the corresponding ester of trichloro-

tertiary butyl alcohol. Analytical data show its composition to be $C_{11}H_{11}O_2Br_3$.

Trihalogen-methyl reactions. IV. Tetrachlorosuccinic acid: HOWARD WATERS DOUGHTY and BENJAMIN FREEMAN. Tetrachlorosuccinic acid is formed by the action of trichloroacetic acid on copper dust in benzene solution. It is a hygroscopic solid which is not very stable, being easily hydrolyzed. The aniline salt (m. p. 149°) and ethyl ester (b. p. 156°/13 mm.) are described. Ammonium trichloroacetate reacts vigorously with copper in aqueous ammonia, losing two atoms of chlorine per molecule. This action also takes place still more vigorously with cadmium and zinc, but not with silver.

Spiro-pyrimidines. II. Cyclohexane-1, 5-spiro-pyrimidines: ARTHUR W. DOX and LESTER YODER. Cyclohexane-1, 1-dicarboxylic ester, prepared by condensation of 1, 5-dibromopentane with ethyl malonate, condenses with urea and with guanidine to form cyclohexane-1, 5-spiro-pyrimidines. These products are very similar in their properties to the corresponding cyclobutane-1, 5-spiro-pyrimidines previously described by the writers. In certain respects they resemble also the dialkylbarbituric acids, but differ from the latter in having a carbon atom common to two rings.

Spiro-pyrimidines. III. Cyclopropane-1, 5-spiro-pyrimidines: ARTHUR W. DOX and LESTER YODER. Cyclopropane-1, 1-dicarboxylic ester, prepared by condensation of ethylene bromide and ethyl malonate, might be expected to condense with urea and substituted ureas and yield spiro-pyrimidines analogous to those obtained from cyclobutane- and cyclohexane-1, 1-dicarboxylic esters. Condensations with urea and with guanidine were readily effected, but the products were invariably amorphous, insoluble substances of great stability. Analyses showed the same percentages of nitrogen as those calculated for the simple spiro-derivatives. It is probable that the cyclopropane ring opens and two or three molecules unite to form a cyclobutane or cyclohexane nucleus with two or three barbituric acid groups attached. The polymer obtained from urea could not be hydrolyzed by long boiling with concentrated hydrochloric acid. Hydrolysis by means of sodium hydroxide gave an acid which lost carbon dioxide on heating, with formation of a crystalline acid, of melting point 151° and neutralization equivalent 86.

Pyrimidines from dialkylmalonic esters and benzamidine: ARTHUR W. DOX and LESTER YODER. In the presence of sodium ethylate at 70–75°, dialkylmalonic esters condense with benzamidine to form derivatives of tetrahydropyrimidine. The dialkyl-malonic esters used were the dimethyl, diethyl, dibutyl, diisoamyl, and dibenzyl. These all gave white products. The corresponding mono-alkyl derivatives were bright yellow. The latter may therefore be regarded as possessing the tautomeric enol structure.

An electrochemical study of certain reversible reductions: J. B. CONANT and H. M. KAHN.

The reactivity of the chlorine atom in the nitrobenzyl chlorides: J. B. CONANT and S. S. NEGUS.

The 1.4-addition of phosphenyl chloride: J. B. CONANT and S. M. POLLACK.

A comparative study of ring stability: NAO UYEI and OLIVER KAMM.

Investigation of isomerism in the diphenyl series: J. H. WALDO, C. S. PALMER and O. KAMM. Fixation of the benzene nuclei in diphenyl derivatives according to the Kaufler-Cain theory leads to the possibility of optical isomerism in the case of certain diphenyl derivatives. Salts of diphenyl-O-carboxylic acid with optically active bases were subjected to crystallization but there was found no conclusive evidence of this type of isomerism. The investigation has been extended also to benzidine derivatives, particularly to benzidine disulfonic acid. The negative results obtained fail to support the recently proposed theories concerning the structure of the diphenyl derivatives.

The action of hydrogen sulphide upon tri-nitrotoluene: F. J. MOORE and E. H. HUNTRESS. In this reaction Cohen and Dakin observed the formation 2-6-di-nitro 4- tolyl hydroxylamine which when boiled with hydrochloric acid yielded a colorless solid which they assumed to be the amine, but later denied this without further characterizing it. They subsequently obtained the true amine by the addition of hydriodic acid. The observation that the above hydroxylamine yields this same compound when treated with silver nitrate raised the suspicion that it might be the azoxy compound. This accounts for the oxygen which ought to have been evolved in the original equation of Cohen and Dakin, for we have shown that 2-6 dinitro-4-tolyamine is formed at the same time.

The constitution of the secondary product in the sulphonation of cinnamic acid: F. J. MOORE and RUTH M. THOMAS. The principal product of the reaction is para-sulpho-cinnamic acid. With this is formed an isomer whose barium salt is much more soluble. This has hitherto been variously de-

scribed as an ortho and a meta compound. It has been supposed to be different from the meta compound prepared by Kaffka from m-sulpho benzaldehyde by the Perkin synthesis. We have shown that it is identical, and also that on oxidation with permanganate it yields meta sulpho benzoic acid. It can be easily characterized by the melting points of its aniline and toluidine salts.

Separation of aromatic primary and secondary amines: I. N. Hultman and H. T. Clarke. The separation of primary and secondary amines can in most cases be carried out satisfactorily by taking advantage of the solubility in alkali of the benzenesulfonyl or toluenesulfonyl derivatives of the primary amines. The recovery of the base from such derivatives is however apt to be troublesome, and in certain instances difficulties are met with in the alkali treatment owing to the ease with which the sodium salts are hydrolyzed. Thus they can be extracted from their solution in alkali merely by shaking with ether; and in cases where only a small quantity of primary base is present, the sulfonyl derivative of the secondary amine acts in the same way as an extracting solvent. This was found to be the case particularly with p-toluidine and its monomethyl derivative. This mixture moreover can not be separated by treatment with zinc chloride solution, as is possible in the case of aniline and methylaniline, since methyl-p-toluidine appears to form an insoluble zincichloride. Advantage can therefore be taken of the observation that primary aromatic amines, on heating to 160–180° with urea are converted into symmetrical diarylureas, while secondary bases, typified by methylaniline, do not react at all with urea. It is thus merely necessary to heat the mixed bases with urea in slight excess over the calculated amount, and treat the product with dilute acid.

Potassium derivatives of the alkyl amines: Edward C. Franklin. By the action of metallic potassium on methyl amine, ethyl amine and dimethyl amine in the presence of platinum black, the compounds represented by the formulas CH_3NHK, C_2H_5NK and $(CH_3)_2NK$ have been prepared.

The existence and reactions of positive halogens attached to carbon in aromatic compounds: Ben H. Nicolet. W. A. Noyes, J. Stieglitz, L. W. Jones and others have interpreted and contributed a large amount of data on the positive nature of halogen attached to nitrogen. Howell and Noyes have shown the I of C_2I_2 to be positive. It is now shown that a number of compounds, most typically p-iodoaniline and 3-iodo 4-toluidine, can be hydrolyzed with acids in such a way that the halogen is replaced by hydrogen, and that the halogen resubstitutes to give di-halogenated products—two proofs of positivity. Such halogens appear to be readily removed (replaced by hydrogen) by heating with $SnCl_2$ and HCl.

Diphenyl-β-naphthylemethyl: M. Gomberg and F. W. Sullivan, Jr. Diphenyl-β-naphthylmethyl was prepared and found to exhibit the characteristic chemical reactions and physical properties of free radicals. Determinations by the cryoscopic method showed that dissociation increased with rising temperature and with dilution. Contrary to the theory that the color of free radical solutions is due to dissociation of the dimolecular to the monomolecular form, investigation by colorimetric methods showed that the increase in color intensity was quite independent of changes in dissociation. It was also found that not more than one third of the monomolecular free radical was in the colored form. From these facts we believe that the color of solutions of free radicals is best explained on the assumption that the dimolecular form dissociates to the mono-molecular form in which equilibrium exists betweeen the colorless benzenoid and the colored quinonoid tautometer.

Contribution to the structure of benzidine: Formation of rings through the m and p positions of benzene: Roger Adams and W. C. Wilson. Benzidine condenses readily with aromatic dialdehydes or ketones of the type represented by terephthalaldehyde and resodiacetophenone, to give condensation products which analyze for one molecule of benzidine plus one molecule of dialdehyde with the elimination of two molecules of water. It is barely possible that these substances consist of two molecules of benzidine with two molecules of dialdehyde, with the elimination of four molecules of water. The substances are too insoluble to allow the molecular weight to be obtained. If these substances are of the simpler type, it is difficult to see how Kaufler's formula for benzidine can be accepted, since his structure assumes that the amine groups are as close together as the amine groups in ophenylenediamine. Benzidine also condenses with the monazine of terephthalaldehyde to produce a product which analyzes for one molecule of each with the elimination of two molecules of water. It is apparent

that ring structures containing a very large number of atoms and connecting the meta and para positions in the benzene nucleus are readily prepared.

The preparation of dihydrobenzene and some of its derivatives: E. C. KENDALL and A. E. OSTERBERG. The use of certain sulfonic acids for the dihydration of quinite or of tetrahydrophenol. The yield of dihydrobenzene from quinite by catalytic action of phenolsulfonic acid is practically quantitative. Dihydrobenzene Δ 1:4 adds hydrochlorous acid and halogens.

Stability of the C-Hg linkage in mercury derivatives of anisole and phenetole: EDMUND B. MIDDLETON and F. C. WHITMORE. The stability of this linkage resembles that of the corresponding linkage in acetylated mercury derivatives of phenol. While the C-Hg linkage in mercury compounds containing a phenolic hydroxyl is broken quantitatively by inorganic iodides and similar reagents the C-Hg linkage in the anisole and phenetole compounds is stable to these reagents. The ortho anisyl and phenetyl mercuric halides give the corresponding R_2Hg compounds. The para compounds form the iodides which remain unchanged. Potassium sulfocyanate gives the same results as the iodides with mercurated phenols, their acetyl derivatives, and mercurated anisoles and phenetoles.

Preparation of mercury ditolyl from tolymercuric chloride: L. FRANCES HOWE and F. C. WHITMORE. Tolylmercuric chloride prepared from toluene sulfinic acid obtained from p-toluene sulfone chloride was treated with the reagents usually used for changing compounds of the type RHgX to those of the type R_2Hg. Metallic copper in alcohol and sodium stannite in water gave very poor yields. Sodium in xylene, aqueous sodium sulfide, and aqueous sodium thiosulfate gave fair yields. Potassium iodide gave an almost quantitative yield. A new reagent for this purpose, potassium sulfocyanate, gave almost as good a yield. Using the sulfone chloride obtained from saccharine manufacture this method is the most convenient for making a mercury diaryl.

Organic compounds prepared from ortho-chloromercuribenzoyl chloride: F. C. WHITMORE and EDMUND B. MIDDLETON. *Preliminary paper.* The acid chloride obtained by the action of thionyl chloride on the anhydride of ortho-hydroxymercuribenzoic acid reacts with alcohols and amino compounds giving mercurated benzoic esters and amides. Compounds have been prepared from methyl alcohol, ammonia, aniline, and p-aminobenzoic acid. These compounds are too insoluble for therapeutic use. The action of more complex alcohols and amino compounds is being studied.

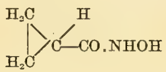
Mercury compounds of normal-butyl: RUTH WALKER and F. C. WHITMORE. n-butyl bromide reacts with dilute sodium amalgam giving a poor yield of mercury dibutyl. Mercuric chloride reacts with butyl magnesium bromide in excess, forming butyl mercuric bromide, calomel, and a small amount of mercury dibutyl. Using an excess of mercuric chloride gives a good yield of butyl mercuric bromide. Heating this substance with an excess of butyl magnesium bromide gives a fair yield of mercury dibutyl, a liquid boiling at 215°. The halide reacts with silver oxide and water giving a water solution of butyl mercuric hydroxide, a strong base. Treatment of this water solution with solutions of sodium halides gives precipitates of the butyl mercuric halides. The mercury butyl compounds are extremely toxic.

Mercury derivatives of meta-nitrobenzoic acid. Preliminary paper: F. C. WHITMORE and V. E. MEHARG. Nitrobenzoic acid fused with mercuric acetate gives a mixture of organic mercury compounds which are stable to sulfides. One of the compounds is 4-Hydroxymercuri-3-nitrobenzoic acid. The position of the mercury is proved by conversion into 4-bromo-3-nitrobenzoic acid. The mercury compounds are soluble in sodium hydroxide and in sodium carbonate. The solution in alkali causes a partial breaking of the C-Hg linkage. The mercury compounds and their reactions are being studied further.

The quantitative determination of paraformaldehyde: PARRY BORGSTROM and W. GRENVILLE HORSCH. Paraformaldehyde was analyzed by four methods and gave by (1) "neutral sulfite" 96.7 per cent., (2) iodimetric 96.7 per cent., (3) oxidation by dichromate, titration of excess 96.3 per cent., (4) oxidation by permanganate (or dichromate) with absorpton of CO_2 96.9 per cent. formaldehyde. For the "neutral sulfite" use 0.5 N to 1.0 N sulfuric or hydrochloric acid, rosolic acid as indicator and 4 N freshly prepared sodium sulfite. In the "iodimetric" method, the base is first added to the paraformaldehyde, then the iodine solution (0.2 N) within one minute time interval. Increasing this time or changing the order in which the reagents are added lowers the apparent formaldehyde content considerably. The remainder of the analysis is as usual. With other methods, ordinary precautions should be observed.

Rearrangements of some new hydroxamic acids related to heterocyclic acids and to diphenyl and triphenylacetic acid: Lauder W. Jones and Charles D. Hurd. Hydroxamic acids of thiophene and furane alpha carboxylic acids yield silver salts of their acyl derivatives which are less readily rearranged than the corresponding derivatives of benzhydroxamic acid. Diphenyl- and triphenylacethydroxamic acids were also examined, and it was found that an increase in the number of phenyl groups occasions greater readiness to rearrange. Diphenylacethydroxamic acid is formed by the action of diphenylketene upon hydroxylamine—a new type of reaction. Triphenylacethydroxamic acid is not produced by the interaction of ethyl triphenylacetate with hydroxylamine, but is quantitatively formed from the acid chloride.

The hydroxamic acid of cyclopropane carboxylic acid and its derivatives: Lauder W. Jones and Alfred W. Scott. The monohydroxamic acid



was prepared in order to determine what effect the trimethylene ring would have upon the Beckmann rearrangement of this compound and some of its derivatives. The hydroxamic acid is a colorless solid which melts at 123°. The benzoyl ester (A) C_3H_5—CO.NHO.CO.C_6H_5 (m. p. 149°) and the acetyl ester (B) C_3H_5—CO.NHO.CO.CH_3 (m. p. 106°), as well as the potassium, sodium and silver salts of these esters were studied. When the salts of (A) were heated gently, they decomposed to give cyclopropane isocyanate and the corresponding benzoates. Their relative stabilities increased in the order given above. When the salts of the alkali metals were heated with water, they showed a pronounced tendency to hydrolyze, which made it difficult to control the reaction so that the usual product of rearrangement, a sym-disubstituted urea, could be obtained. Unexpected stability was encountered in the case of the potassium salt of the acetyl ester (B) which is but little decomposed at 190°. The silver salt of this ester, unlike silver salts, was readily soluble in a mixture of alcohol and water, or in water alone.

The preparation of phenyl acetylene: John C. Hessler. Nef's method of preparing phenyl acetylene was to heat ω-bromstyrene in a sealed tube with alcoholic potassimu hydroxide. He used only a small quantity of alcohol in order to minimize the yield of the by-product, phenyl-vinyl ethyl ether. The writer's method is to allow the bromstyrene to flow, drop by drop, upon molten caustic potash contained in a flask heated in an oil bath at 200 to 220°. The phenyl acetylene distills over as it is formed, carrying with it only traces of unchanged bromstyrene. Yield: 80 per cent. of the theory of purified product.

On a quantitative study of the Grignard reagent: H. Gilman, P. D. Wilkinson and W. P. Fishel. In connection with some work on the addition of the Grignard reagent to ethylenic hydrocarbons, a method for the quantitative estimation of this reagent was found desirable. For this purpose a number of methods are being investigated, among them, (1) titration with iodine, (2) an indirect analysis involving the determination of the magnesium and alkyl halide actually used, and (3) an extension of the Zerewitinoff method involving the measurement of hydrocarbons given off when the Grignard reagent is treated with a compound containing "active" hydrogen. The first of these methods, that of titration with iodine, has been found unsuitable. In this connection the optimum conditions for the formation of the Grignard reagent are being studied.

A simple type of glass pressure bottle: R. R. Read. The apparatus consists of a simple adaptation of the common soda siphon to the purpose of a glass pressure flask.

An indirect method of mercurization of organic compounds and a method of carbon linking: Morris S. Kharasch. The method consists of heating the mercury salts of carboxylic acids, which lose carbon dioxide readily, the mercury then taking the position originally occupied by the carboxyl groups. Also, since the mercury can be readily replaced by a halogen, the method enables one to substitute a carboxyl group by a halogen. It was also found that the mercury compounds thus formed, especially those of the aliphatic series, can be made to split off mercury, thus linking the two carbon atoms. In the aromatic series, in the case of carboxylic acids which do not lose carbon dioxide readily, the mercury usually orients ortho to the carboxyl group. However, if a negative group is present in the molecule, the mercury orients itself ortho to that group, irrespective of the position of the negative group. In this respect, a number of substituted benzoic acids have been investigated.

Charles L. Parsons,
Secretary

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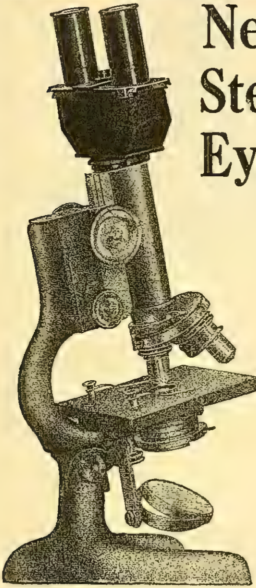

SCIENCE

Friday, July 15, 1921

CONTENTS

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THE RESPONSIBILITY OF THE BIOLOGIST IN THE MATTER OF PRESERVING NATURAL CONDITIONS

The writer has accepted a joint chairmanship of the Committee on the Preservation of Natural Conditions of the Ecological Society of America. The special task undertaken by him is to interest some of our leading scientific organizations and institutions in a proposed affiliation for the purpose of making "a more serious effort to rescue a few fragments of vanishing nature."

I am only too painfully aware of the fact that this task might have been undertaken by others with much more promise of success. There are many in the ranks of American biologists whose scientific prestige and administrative ability would carry far greater weight than mine. There are many who could—if they would—undertake this plain duty without risk to their health and without serious curtailment of their output in the field of research. It is my hope that more of our leaders in science will be aroused to the necessity of becoming also leaders in the conservation movement. I for one will welcome the day when this leadership will pass into their hands. In the meantime, I shall be glad, if only in a slight degree, to play the rôle of an enzyme or catalyzer, which may provoke effective energy transformations in others.

That both our native fauna and flora and our natural scenery are disappearing at an appalling rate is obvious to all, except those whose interests and outlook are bounded by the walls of their laboratories. Despite the indignant denials of some, I am afraid that this last type of individual is not wholly mythical. But the great bulk of the apathy with which we have to contend is doubtless due to another cause. This is a spirit of

fatalism—the sullen acceptance of a situation which is regarded as inevitable. What can a few dreamers do to stem the tide of such powerful biological and social forces as the prevailing spirit of commercialism, the concentration of present-day mankind in cities, with a resulting dominance of the urban viewpoint, and particularly the resistless pressure of increasing population everywhere?

Whether in the future these calamitous tendencies will be voluntarily checked by the intelligent concerted action of mankind, or whether they will be checked automatically by some world-wide catastrophe, need not concern us here. Ultimately some endurable balance will be struck between the human population of our globe and the available amount of food, space and other conditions essential to life. For all we know, this unbridled growth of population *may* be halted before the world is utterly congested, and while there are still large areas in a more or less primitive condition. Does not this last supposition contain enough of probability to warrant its acceptance as a guiding principle of action? Is it not worth while to reserve from settlement and exploitation extensive tracts of the earth's surface, representing at least the most interesting types of fauna and flora and physiography?

We have made a brave beginning in this direction, with our national and state parks, our national forests, national monuments, game refuges and the like, though it must be confessed that these reservations are still continually threatened by predaceous interests and that their permanence is not in the least assured.[1] But we should carry these efforts vastly further. The areas chosen should be more numerous and more diversified. A greater variety of motives should be given scope in achieving these ends. Economic considerations, such as the conservation of lumber and water-power, should still be recognized as immensely important, as should also the need for public recreation grounds. But purely scientific considerations should likewise be accepted as legitimate reasons for reserving tracts from settlement or molestation.

[1] Witness the present federal water-power act (now happily amended), and the recent attempts to raid the Yellowstone.

Work of fundamental importance regarding the phenomena of heredity has been done in our laboratories, experimental gardens and breeding-pens, and much of this work bears more or less directly upon the problems of organic evolution. But there are many of us who feel that these problems can not be solved without a very intensive study of the products of evolution in nature. To try to arrive at an explanation of the "origin of species" without an adequate analysis of the phenomena of geographic variation, and the interrelationships of our species and subspecies in the wild, seems to some of us utterly bizarre.

So far, so good, but what can we do about it? This is naturally the hardest question of all to answer. To seek advice on this subject is my main excuse for writing this article. Let me say before going further that I do not make the absurd claim that I or my colleagues on this committee are solitary voices crying in the wilderness. Many and powerful are the influences already enlisted in support of one or another movement toward the protection of wild life and of natural scenery. And the concrete results, in terms of actual achievement, would require scores of pages even to outline. Many of these results have become incorporated into our laws and our machinery of government.

It is my purpose here to point out two fundamental needs: (1) the need of some one or more national organizations whose duty it shall be to coordinate all these activities and impulses, and (2) the need that our scientific men, and particularly our biologists, shall play a far greater part in this movement than they have ever done in the past. I shall speak of this second point first.

Biologists, above all others, should be in a position to appreciate the loss to science which results from the destruction either of single natural species or of natural associations of species. They are in a unique position to give advice as to what particular species and

associations are of greatest importance to science, and as to which ones are in most urgent need of protection. It is likely, too, that many of our number are in a position to suggest the most promising methods of protection. At least, no others are probably so well qualified to do so.

Most of all, perhaps, the influence of the biologist is needed in counteracting the dominant utilitarian or materialistic trend of the day. He should be on hand to register his insistence upon the recognition of claims that are not expressible directly or remotely, in dollars and cents, or in the merely quantitative expansion of our civilization. If he camouflages his true feelings by talking in the current language of the market-place, he is, to that extent, a traitor to our cause. The conservation of our material resources can be depended upon to take care of itself—in the future, if not in the past. Some of the great commercial interests themselves are beginning to insist that a sane policy be adopted in these matters. But the cause of science—genuine science—in the public mind, is still very weak, and needs every ounce of energy which can be thrown into its support. How, let us again ask, can this energy be most effectively brought to bear at the present time? This is, in a large degree, a question which I am asking my readers, rather than attempting to answer here.

Unlike, as I believe, the case of researches which are directed toward the discovery of general principles, a practical project like the one in hand can only be accomplished by the aid of a high degree of organization. What form this organization will ultimately take, in the present instance, is hard to forecast. It is my belief that sooner or later its administration must be in the hands of men who are willing and able to make this their life work. Such men will probably be hard to find. The university biologist, however gifted otherwise, is commonly neither willing nor able to achieve success along these lines. On the other hand, a mere high-grade clerk, the counterpart of some of our bureau or division chiefs in the government service, would probably make an even more lamentable failure. A broadly trained field naturalist, with a more than usual endowment of public spirit and administrative talent, would doubtless fill the bill. His salary should be commensurate with his great responsibilities. He should have a staff of expert assistants, giving much of their time to first-hand observations of the unequal struggle between man and nature, and to actual surveys of proposed reservations. Furthermore, this important official should have an adequate office force. These are minimum requirements.

Who would foot the bill? I don't know. I have never had anything to do with raising funds for major enterprises. In reply, however, I will ask another question: Is not the preservation of large fractions of our fauna and flora and landscape, in their natural condition, a project calculated to stir the imagination of money-givers of the sort that have endowed various other enterprises for the welfare of mankind?

The actual administration of any tracts of land, set aside as natural preserves, would doubtless devolve upon the national or the state governments. The cost of purchasing this land might be met either by private donations or by government or state appropriations. But the cost of conducting such preliminary surveys as I have suggested, together with the necessary nation-wide educational campaign, would doubtless have to be defrayed out of funds from purely private sources. And these funds would need to be large.

I have deferred to the last the specific proposals which I have to make. The type of organization which I have outlined above is not yet in existence. So far as I know, neither the men nor the funds are in sight at present. Furthermore, should any such central bureau or clearing-house for conservation activities be established, it would have to work, in a large degree, through the various existing organizations. Prominent among these, at the present time, is the Ecological Society of America, which has devoted much effective labor toward interesting Amer-

ican biologists in the preservation of natural conditions. This society, with its special committee, would doubtless expect to continue actively in the field, even if the administrative and coordinating functions should be largely handed over to another body. The actual relations betwen the two must be left to the future to decide. It is entirely probable that an amicable and satisfactory solution will be reached when the problem presents itself.

In the meantime, this committee proposes to seek the support of various other organizations which may be interested in achieving the same ends. The present writer has undertaken to solicit the cooperation of some of our principal scientific societies, museums, universities and research institutions. Individual letters will doubtless be sent to the officers of many of these organizations in due time. Matters will be greatly expedited, however, if such officers will take the initiative into their own hands and will communicate with the committee as to what assistance they personally, or the organizations which they represent, are prepared to render.

The assistance might be of various sorts. (1) It might take the form of a mere endorsement or pledge of moral support to the Ecological Society's conservation activities. Such an endorsement, particularly if published in one of the scientific journals, would give to these activities a certain degree of publicity, as well as an added importance in the eyes of many persons. Some recent resolutions of the American Association for the Advancement of Science, the American Society of Zoologists and the Botanical Society of America are cases in point.[2] Unfortunately, however, most of our national scientific societies have thus far shown no interest in the conservation of nature. The officers of one leading biological society decided a year ago that the subject was not germane to the purposes of their organization, and a resolution which had been drafted by one of its members was not even brought to a vote.

(2) Some of these societies might well be expected to go much further than voting a mere cut-and-dried endorsement of conservation activities. Why should not occasional papers, lectures or even symposia in this field be regarded as appropriate material for their programs? Many of the data which are made use of in the campaign for the preservation of natural conditions are likewise of high scientific interest. Various results of disturbing the balance of nature might be mentioned in this connection.

(3) Advice would be welcomed as to lines of activity which the committee might profitably undertake. Suggestions as to possible methods of "organizing" the various scientific interests are to be included here.

(4) Financial assistance is needed, even for this committee's present limited activities. The suggestion has been made that some of the scientific societies might be willing to contribute a certain fraction of their annual dues to the Ecological Society for the purpose of supporting its conservation activities. An appeal has already been made to the National Research Council for a grant for this purpose.

As an aid in the promotion of these ends it has been proposed that the various scientific and research organizations so disposed should form some sort of a loose federation or association of "societies interested in the preservation of natural conditions." This would be likely to promote the interchange of ideas, and effectiveness of action, where action seemed called for. The constituent societies would presumably appoint delegates to the meetings of this federation; these delegates being such of their members as have shown the most active interest in conservation matters. Such a federation would naturally have some organic relation to the Ecological Society's committee. Its efforts, at present, might be effective in several directions: publicity and education, endorsement of or opposition to proposed legislation, actual investigations of specific cases in which emergency measures seem to be necessary, and perhaps some others.

The writer would welcome opinions from the officers of these societies as to the desirability of forming such a federation. He would also greatly appreciate any suggestions

[2] Science, January 7 and January 28, 1921.

or advice regarding the matters covered by the foregoing article, even if these take the form of destructive criticism. It seems to me that here, as in so many other cases, no far-reaching plans should be adopted until we have had a free discusion in which all angles of the subject have been considered. I am therefore hopeful that this communication may call forth replies, either addressed to me personally or published in the columns of SCIENCE.[3]

F. B. SUMNER

SCRIPPS INSTITUTION FOR BIOLOGICAL RESEARCH, LA JOLLA, CALIFORNIA

[3] Those who are desirous of reading fuller discussions of wild life conservation and the preservation of natural conditions are referred to articles by Harper ("Natural History," Vol. XIX., 1919), Van Name (SCIENCE, July 25, 1919), and Sumner (*Scientific Monthly*, March, 1920). Two books by Hornaday are also to be recommended: "Our Vanishing Wild Life" (N. Y., Scribner's, 1913), and "Wild Life Conservation in Theory and Practise" (Yale University Press, 1914). The Ecological Society of America is likewise about to publish a brief résumé of the "Reasons for Preserving Natural Areas," which will doubtless be rather widely distributed.

THE NATIONAL GEOGRAPHIC SOCIETY COMPLETES ITS GIFTS OF BIG TREES

THE trustees and officers of the National Geographic Society are deeply gratified to announce to members that the society has been continuing its effort, begun in 1916, to preserve the Big Trees of Sequoia National Park.

By a final purchase in April, 1921, of 640 acres of land in Sequoia National Park, these famous trees, oldest and most massive among all living things, the only ones of their kind in the world, have been saved; they will not be cut down and converted into lumber.

Were a monument of human erection to be destroyed, it might be replaced; but had these aborigines of American forests been felled, they would have disappeared forever. The Big Trees could no more be restored than could those other survivals of indigenous American life, the red man and the buffalo, should they become extinct.

Members of the National Geographic Society will recall that, in 1916, Congress had appropriated $50,000 for the purchase of certain private holdings in Sequoia National Park, but the owners declined to sell for less than $70,000. In that emergency the National Geographic Society took the first step toward saving the Big Trees by subscribing the remaining $20,000. Thus 667 acres were purchased. The society's equity in them was conveyed to the government, and this tract became the property, for all time, of the American people.

In 1920, inspired by the first benefaction, three members of the society gave the society sums equivalent to the purchase price of $21,330 necessary to acquire three more tracts, aggregating 609 acres. Thus the original area of Sequoias saved from destruction was almost doubled.

At the request of the donors, this area was presented to the government by the National Geographic Society in June, 1920. This gift was made possible by the generosity of Stephen T. Mather, director of national park service, who personally contributed $13,130; by D. E. Skinner, of Seattle, who contributed $5,000; and by Louis Titus, of Washington, D. C., who contributed $3,200.

There still remained one other important private holding in Sequoia National Park amounting to 640 acres. Through this tract, which is covered by a splendid stand of giant sugar-pine and fir, runs the road to Giant Forest.

To acquire this approach to the unique forest and to eliminate the last of the private holdings in this natural temple, the National Geographic Society and friends of the society, in 1921, contributed $55,000, with which the tract was purchased. On April 20, 1921, it was formally tendered in the name of the society, through Secretary of the Interior Albert B. Fall, to the American people.

This sum of $55,000 includes $10,000 from the tax fund of Tulare County, California, within which the Sequoia National Park is

situated, a practical evidence that the people closest to the park are alive to the importance of our government owning the land.

The contributors and the amounts contributed were:

Research Fund of the National Geographic Society	$ 5,000
W. F. Chandler, Fresno, California	6,000
George F. Eastman, Rochester, New York	15,000
William Kent, Kentfield, California	250
Stephen T. Mather, Director National Park Service	14,000
Charles W. Merrill, Berkeley, California	250
James K. Moffit, San Francisco	500
John Barton Payne, former Secretary of Interior	2,000
Julius Rosenwald, Chicago, Illinois	1,000
Rudolph Spreckels, San Francisco	1,000
Special Tax Levy of Tulare County, California	10,000
	$55,000

Thus the National Geographic Society has conveyed to the United States government a total acreage in Sequoia National Park of 1,916 acres, purchased at a total cost of $96,330.

It should be noted that the gifts were not solicited by the society. The National Geographic Society asks its membership for no contributions of any sort. Its publications and its scientific and educational activities are entirely supported by their dues.

Every member of the society may feel that he had a part in this enduring gift to his country and to posterity, for the funds appropriated directly by the society for the purchase of the Sequoias came from the fraction of the dues of members set aside for such benefactions.

The tender was made in the name of the National Geographic Society because, as the director of the National Park Service, Mr. Mather, put it:

It is only proper that this gift should come to the government through the National Geographic Society, in view of the keen interest which the society has taken in the purchase of the other private holdings in this park. It was through direct gifts by your society that we were able to save the Giant Forest, which contains the finest stand of *Sequoia Washingtoniana* in the Sierra.

Following the presentation, Albert B. Fall, Secretary of the Interior, wrote to Gilbert Grosvenor, president of the National Geographic Society:

Dear Mr. Grosvenor: It was a very pleasant surprise when you called on me on April 20 and, on behalf of the National Geographic Society, presented the title deeds and other pertinent papers conveying to the United States the so-called Martin tract of 640 acres in the Sequoia National Park, recently purchased at a cost of $55,000 by your Society, through the generosity of its members, in order that this area with its fine stand of trees might be preserved for the American people.

I have already personally expressed to you my sincere thanks and my acceptance of the proffered gift. Your society on several preceding occasions has stepped in at a critical moment and acquired several similar areas in this same park, thereby saving from extermination other wonderful trees that would otherwise have fallen under the axe.

Your society is to be highly commended on its substantial expression of a high public spirit, and on behalf of the United States I again want to express to you, and through you to the contributors, my deepest appreciation of your generous and considerate action.

Respectfully,

Albert B. Fall

Mr. Gilbert Grosvenor,
President, National Geographic Society,
Washington, D. C.

To mankind, throughout the ages, trees have been the most human-like, the most companionable, of all inanimate things. Aristotle thought they must have perceptions and passions. An infinitely more scientific generation still is sensible to their mystical power.

More and more will Americans visit Sequoia National Park to gaze upon the majesty of "Nature's forest masterpieces" in their last stand. National Geographic Society members may well be proud that they had a part in preserving for all time these mementos of a past far beyond the records of written history.

MEETING OF THE EXECUTIVE COMMITTEE OF SIGMA XI

The executive committee of the Sigma XI Society held its annual spring meeting in New York on May 21.

Careful consideration was given to requests for chapters from a considerable number of institutions and arrangements made in individual cases to recommend the granting of certain charters by the Convention to be held next winter. In other cases petitions were laid over without prejudice for further information and future action.

It was reported that the National Research Council had voted to recognize Sigma Xi by appointing the president as an ex-officio member of the executive board.

The invitation from the Royal Canadian Institute to hold the mid-winter convention in Toronto was accepted and the date fixed for Wednesday, December 28. The convention will be held in the afternoon and the dinner in the evening of that day.

The report of the fellowship committee showed sufficient funds already at hand to assure the success of the plan and it was voted to establish one or more Sigma XI fellowships for the year beginning September, 1921. The Ph.D. degree or its equivalent was decided upon as a prerequisite for appointment, and a sub-committee consisting of Professor Edward Ellery (Union College) and Professor F. K. Richtmyer (Cornell University) was appointed with authority to fix the stipend and to recommend appointments as well as the precise terms under which the fellowships will be maintained. In view of the fact that provisions had already been made under direction of the National Research Council for fellowships in physics and chemistry during the next five years it was voted that, at least for next year, Sigma XI will give preference to other sciences in making the awards of its fellowships.

The membership committee recommended certain changes in order to make possible a wider enlistment of the membership in the work of the society. The preliminary plan includes the division of the organization into members and associates, with the recognition of two groups distinguished on a functional basis, viz: chapter members and associates and general members and associates. The chapter functions will remain unchanged, whereas the members and associates in the general group will participate in the advancement of research through the national convention, the fellowship movement, conferences at scientific meetings, Sigma Xi clubs and such other activities as do not infringe on the rights and privileges of the active chapters. It seemed advisable that the general group should have at least one representative on the executive committee, the representation from the active chapters being then four elective members on that committee. This subject will be more definitely formulated for discussion at the coming convention.

Several minor constitutional amendments were discussed and formulated for presentation through the chapters in the customary manner.

Henry B. Ward,
Secretary

BERKELEY MEETING OF THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE AD- ADVANCEMENT OF SCIENCE

The fifth annual meeting of the Pacific Division of the American Association for the Advancement of Science will be held from August 4 to 6 at Berkeley, California, in quarters provided by the University of California. Previous meetings in the order named have been held at San Diego, Stanford University, Pasadena and Seattle. The location at Berkeley will insure a large attendance, as many members of the Pacific Division are resident in the San Francisco Bay region.

Fourteen affiliated societies whose announcements follow will participate in the Berkeley meeting.

GENERAL SESSIONS

Features of the general sessions in which the membership of the Pacific Division and affiliated societies will unite are set forth in

the preliminary announcement of the executive committee as follows:

The Research Board of the University of California is arranging a research conference to be held at the luncheon hour on Thursday, August 4. The special topic for discussion will be "A Survey of Research Conditions in Pacific Coast Institutions." The meeting will be open to members of the Pacific Division and of affiliated societies who are particularly interested in the development of research in Pacific coast colleges and universities.

THURSDAY, AUGUST 4, 2:00 P.M., IN WHEELER HALL

Science and the Public Health

Following the plan so successfully introduced at the Pasadena meeting in 1919, and successfully continued at the Seattle meeting in 1920, of attempting some constructive application of scientific knowledge to important problems of the day, there has been arranged for this meeting a symposium on the afternoon of August 4. The subject is that of the relation of science to public health—a subject with which every one is vitally concerned. An analysis of the vote on each of the four so-called "health amendments" upon which the electorate of California was permitted to express its views at the general election last November, is all that is required to enable one to realize the seriousness of the situation and the necessity for a campaign of education. The public should be fully informed as to what the adoption of those amendments would really mean. To assist the public to a realization of the seriousness of this menace to scientific investigation and to the public health, a symposium has been arranged in which the question will be presented from different viewpoints, as follows:

Public health and human welfare: DR. RAY LYMAN WILBUR, president, Leland Stanford Jr. University.

Whose business is the public health? DR. F. P. GAY, professor of pathology, University of California.

Education in relation to public health and medical practise: DR. S. J. HOLMES, professor of zoology, University of California.

Physical health and mental health: DR. PHILIP KING BROWN, president of the California Tuberculosis Association, San Francisco.

Rural and Industrial Sanitation: DR. C. A. KOFOID, professor of zoology at the University of California.

Public health and experimental biology: DR. H. B. TORREY, professor of zoology, University of Oregon.

Immediately following the close of the symposium, a general session of the Pacific Division will be held for the purpose of electing four members of the executive committee.

THURSDAY, AUGUST 4, 8:00 P.M., IN WHEELER HALL

On the evening of August 4, President David P. Barrows, of the University of California, will give an address of welcome to which response will be made by Dr. Barton Warren Evermann, chairman of the executive committee. This will be followed by the address of the retiring president of the Pacific Division, Dr. William E. Ritter, who will speak on "Scientific Idealism." After the address of the president a reception will be held. The public is cordially invited to attend this and all meetings and lectures of the Pacific Division and of the affiliated societies.

A public address will be given on the afternoon of August 5 by Professor Henry Norris Russell, professor of astronomy, Princeton University, on "The properties of matter as illustrated by the stars."

A banquet will be arranged for the evening of August 5 for all members of the Pacific Division and affiliated societies. The cost per plate will not exceed $2.00.

Astronomical Society of the Pacific

CHARLES S. CUSHING, president, First National Bank Building, San Francisco.

D. S. RICHARDSON, secretary-treasurer, 22 Battery St., San Francisco.

Meetings of the Astronomical Society of the Pacific will be held in Room 1, Students' Observatory, University of California, Berkeley,

at 9 o'clock, on Friday morning and 2 o'clock on Friday afternoon, August 5. An excursion to Lick Observatory, Mount Hamilton, is planned for the afternoon and evening of Saturday, August 6. All members of the American Association for the Advancement of Science desiring to make this trip should communicate with Mr. W. F. Meyer, Students' Observatory, University of California.

The American Physical Society

THEODORE LYMAN, president, Harvard University.
D. C. MILLER, secretary, Case School of Applied Science.
E. P. LEWIS, local secretary for the Pacific Coast, University of California.

The American Physical Society will hold a meeting on August 4, from 9:30 A.M. to 12:00.

American Phytopathological Society, Pacific Division

H. S. REED, president, Citrus Experiment Station, Riverside.
S. M. ZELLER, secretary-treasurer, Oregon Experiment Station.

The American Phytopathological Society, Pacific Division, will hold four sessions for the discussion of diseases of the deciduous fruits, semi-tropical fruits, cereals and potato, August 4 to 6.

California Section, American Chemical Society

WILLIAM C. BRAY, chairman, University of California, Berkeley.
LLOYD W. CHAPMAN, secretary-treasurer, 531 Rialto Building, San Francisco.

The affiliated sections of the American Chemical Society will hold a joint meeting on August 5, at 9:00 o'clock.

California Section, The Society of American Foresters

DONALD BRUCE, chairman, University of California, Berkeley.
WILLIAM C. HODGE, secretary-treasurer, 425 Call Building, San Francisco.

The various sections of The Society of American Foresters will hold a joint meeting with the Western Society of Naturalists and The Ecological Society of America.

Cooper Ornithological Club
Northern Division

CURTIS WRIGHT, JR., president, 6436 Benvenue Ave., Oakland, Calif.
MRS. JAMES T. ALLEN, secretary, 37 Mosswood Road, Berkeley.

Southern Division

LOYE HOLMES MILLER, president, State Normal School, Los Angeles.
L. E. WYMAN, secretary, Museum of History, Science and Art, Los Angeles.

The Cooper Ornithological Club will hold a meeting on the evening of August 3 at 8 o'clock in Room 9, Museum of Vertebrate Zoology, University of California.

The Ecological Society of America

STEPHEN A. FORBES, president, University of Illinois, Urbana, Illinois.
A. O. WEESE, secretary-treasurer, Vivarium Building, Champaign, Illinois.

The Ecological Society will hold joint meetings on August 4 and 5 with the Western Society of Naturalists, the Pacific Fisheries Society and The Society of American Foresters.

Pacific Coast Entomological Society

EDWIN C. VAN DYKE, president, University of California, Berkeley.
FRANK E. BLAISDELL, SR., secretary-treasurer, 1520 Lake St., San Francisco.

A program has been arranged for August 6. There will be a dinner on August 4 and a field excursion on August 7.

Pacific Fisheries Society

JOHN N. COBB, president, University of Washington.
GEORGE F. SYKES, secretary, Oregon Agricultural College.

The Pacific Fisheries Society will hold two sessions during the forenoons of August 4 and 5. Papers will be presented dealing with the artificial propagation of fishes, and other subjects pertaining to the conservation of the fisheries.

Pacific Slope Branch, American Association of Economic Entomologists

E. O. Essig, chairman, University of California, Berkeley, Calif.

A. L. Lovett, secretary-treasurer, Oregon Agricultural College, Corvallis, Oregon.

There will be scientific programs on August 4 and 5 and excursions on August 6 and 7. An entomological dinner has been arranged for August 4.

San Francisco Society, Archeological Institute of America

David P. Barrows, president, University of California.

H. R. Fairclough, secretary, Stanford University.

A meeting of the San Francisco Society, Archeological Institute of America, will be held Thursday morning, August 4, at which papers will be read by members and others interested.

Seismological Society of America

Otto Klotz, president, Dominion Astronomical Observatory, Ottawa, Canada.

S. D. Townley, secretary-treasurer, Stanford University, California.

A meeting of the Seismological Society of America will be held, the details of which will be given in the final program.

Southern California Section, American Chemical Society

Stuart J. Bates, president, California Institute of Technology.

H. L. Payne, secretary, 223 West First St., Los Angeles, Calif.

The Southern California Section of the American Chemical Society will join with the other sections of the American Chemical Society in a meeting to be held on Friday morning, August 5.

Western Society of Naturalists

J. Frank Daniel, president, University of California.

Chester Stock, secretary-treasurer, University of California.

The Western Society of Naturalists will meet at the University of California in conjunction with the meetings of the Pacific Division. Sessions for presentation of miscellaneous scientific papers on biology will be held on the mornings of August 4 and 5 and at other times during the progress of the general meetings should there be additional papers to be presented.

SCIENTIFIC EVENTS

JOHN HARPER LONG

The many friends of the late Professor John Harper Long, for thirty-seven years professor of chemistry in Northwestern University, will appreciate the portrayal of the man as a teacher, investigator, public servant and friend, contained in the small volume entitled "John Harper Long,—A Tribute from his Colleagues." It is edited by Dr. Robert H. Gault of Northwestern University, contains a chapter by F. B. Dains, entitled "Student, Teacher and Chemist," one by F. Robert Zeit, "A Colleague at the Medical School," another by Ira Remsen on "Dr. Long as a Member of the Referee Board," and an appreciation of the last ten years of Dr. Long's scientific work by Julius Stieglitz and Paul Nicholas Leech. Dr. Frank Wright reviews Dr. Long's activities in connection with Chicago's gigantic drainage problems and the volume concludes with a comprehensive bibliography of Dr. Long's publications, comprising one hundred and eighteen contributions.

There is thus compassed in seventy pages, tastily arranged, a fitting tribute to a man who did so much for chemistry and education. One outstanding feature of Dr. Long's professional life comes back vividly to the reviewer, a characteristic which indexed well his deep, unselfish interest in his profession, namely, his constant attendance and active, helpful participation in the national and sectional meetings of the American Chemical Society. Even long after his health should have demanded more consideration of self, he gave unstintingly of his time, his counsel and his uplifting ideals, to the organization which had given him its highest honor.

The edition is limited to a thousand and copies may be obtained through Professor

Robert H. Gault, Northwestern University, Evanston, Illinois.

W. Lee Lewis

THE SCHOOL OF ENGINEERING OF PRINCETON UNIVERSITY

The trustees of Princeton University have planned to enlarge its school of engineering, giving courses in civil engineering, electrical engineering, mechanical engineering, chemical engineering and mining engineering. These courses will extend over four years, at the end of which time the bachelor's degree will be given. A fifth year will be required for an engineering degree. The plan of the school is one which will not compete with those of engineering schools giving a four-year course, the intention being to make each of the courses mentioned such that the student will secure sufficient engineering training in four years to become an assistant to an engineer, and so be self-supporting, and in addition receive a thorough grounding in physics, chemistry, mathematics, languages, literature, philosophy, economics and sociology to give him a broad outlook on everyday problems. The endeavor will be to make an engineer rather than a specialist. The fifth year is to be devoted primarily to engineering subjects, including certain courses in engineering economics and possibly a limited amount of research. Professor Arthur M. Greene, Jr., of the Rensselaer Polytechnic Institute, has been called to become the dean of the new school and professor of mechanical engineering; he will take up his duties in the fall of 1922. Professor Greene has served as manager and vice-president of the American Society of Mechanical Engineers and at present is chairman of the research committee of the society, a member of the Boiler Code Committee and chairman of its Special Committee on Steam Piping. He is one of the society's representatives on the Engineering Division of the National Research Council and on the Executive Board of the Federated American Engineering Societies.

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

The Board of Scientific Directors of the Rockefeller Institute for Medical Research announces the following promotions and appointments:

Dr. Frederick L. Gates, hitherto an associate in pathology and bacteriology, has been made an associate member.

Dr. Frederic S. Jones, hitherto an associate in the department of animal pathology, has been made an associate member.

Dr. Goronwy O. Broun, hitherto a fellow in pathology and bacteriology, has been made an assistant.

The following new appointments are announced:

Dr. E. V. Cowdry, associate member in pathology and bacteriology.

Dr. Albert Fischer, assistant in experimental surgery.

Dr. William A. Hagan, assistant in the department of animal pathology.

Dr. Albert B. Hastings, assistant in chemistry.

Dr. Hugh J. Morgan, assistant in medicine.

Mr. David I. Hitchcock, fellow in general physiology.

Mr. James M. Neill, fellow in medicine.

Dr. John Auer, hitherto an associate member in physiology and pharmacology, has accepted a position as professor of pharmacology at St. Louis University.

Dr. Francis G. Blake, hitherto an associate member in medicine, has accepted a position as professor of medicine in Yale University School of Medicine.

Dr. J. Harold Austin, hitherto an associate in medicine, has accepted a position as professor of research medicine at the University of Pennsylvania.

Dr. Glenn E. Cullen, hitherto an associate in chemistry, has accepted a position as associate professor of research medicine at the University of Pennsylvania.

Dr. William C. Stadie, hitherto an associate in medicine, has accepted a position as assistant professor in medicine at Yale University School of Medicine.

Dr. Martha Wollstein, hitherto an associate in pathology and bacteriology, has ac-

cepted a position as pathologist at the Babies Hospital, New York City.

Dr. Israel J. Kligler, hitherto an associate in bacteriology, has accepted an appointment with the Zionist Medical Unit in Palestine.

SCIENTIFIC NOTES AND NEWS

Dr. F. H. Knowlton, of the U. S. Geological Survey, received the honorary degree of doctor of science from Middlebury College, at its recent commencement.

Professor Lawrence J. Henderson, of Harvard University, has been elected a foreign correspondent of the Paris Academy of Medicine.

Dr. H. S. Washington, of the Geophysical Laboratory, Carnegie Institution of Washington, has been elected a foreign honorary member of the Norwegian Academy of Sciences.

Professor Florian Cajori, of the University of California, has been elected fellow of the American Academy of Arts and Sciences.

Dr. A. Smith Woodward, keeper of geology in the British Museum of Natural History, has been elected president of the Linnean Society of London.

Dr. George M. Piersol, who has been professor of anatomy in the University of Pennsylvania for thirty years, is retiring from active service.

Dr. Michael E. Gardner has been appointed chief of the bureau of preventable diseases and director of the bacteriologic laboratory of the United States Public Health Service.

The Albert medal of the Royal Society of Arts for 1921 has been awarded to Professor J. A. Fleming in recognition of his contributions to electrical science and its applications.

Charles F. Rand, chairman of the executive board of Engineering Foundation, has been elected an honorary member of the Iron and Steel Institute of Great Britain. Mr. Rand is honorary secretary of the John Fritz Medal Board of Award in London which recently bestowed the John Fritz Medal for achievement in applied science on Sir Robert Hadfield. On July 8 the mission went to Paris to confer the John Fritz Medal for 1922 upon Eugene Schneider, head of the Creusot Works.

George Otis Smith, director of the United States Geological Survey, sailed for England on July 9 on the *Cedric* to attend the meeting of the organization committee of the International Geological Congress in London on July 20. Professor R. W. Brock, of the University of British Columbia, the chairman of this international committee, is the other representative of the Western Hemisphere. The last meeting of this congress was held in Canada in 1913, when Belgium invited the congress to meet in Brussels in 1916. This invitation has been renewed for 1922.

Dr. William H. Welch, director of the school of hygiene and public health, Johns Hopkins University, is among those who will attend the dedication of the new buildings of the Peking Union Medical College, at Peking, China, in September.

Professor Thomas Hunt Morgan, of Columbia University, is spending the last few months of his sabbatical leave at the University of California, where he and his group of assistants are continuing their genetic investigations of *Drosophila*. The other members of the party are Dr. A. H. Sturtevant, Dr. C. B. Bridges, Dr. D. E. Lancefield, Mrs. D. E. Lancefield and Miss Phoebe Reed, cytologists, and Miss Edith Wallace, artist. The party will remain at the university until the opening of Columbia University about Sept. 15.

Thomas Forsyth Hunt, dean of the college of agriculture at the University of California, has returned to the university after a year's travel and study in Italy, Sicily, Egypt, England and Scotland. The main purpose of his trip was to make a survey of European methods of agriculture with special reference to fruit production and its effect upon the progressive development of various nations.

Dr. O. G. F. Luhn, of Larawok, Borneo, recently arrived at the University of California

Farm at Davis to spend some time in the study of cereal crops and cultural methods in behalf of the British government. Dr. Luhn expects to introduce California methods of culture and of cropping into Borneo when he returns.

Captain Roald Amundsen arrived at Seattle on July 4 from Nome, Alaska, where he appeared the middle of June after leaving his schooner, the *Maude,* at Cape Serge disabled by a broken propeller. Captain Amundsen said he still considered entirely feasible his project to drift across the North Pole with the current. He expects to remain in this country a year before proceeding with his voyage.

The Buffalo Society of Natural Sciences held a radium exhibit at its new museum on June 17 in honor of the visit to Buffalo of Mme. Curie, who was presented with honorary membership in the society. The address on radium was delivered by Dr. Edward J. Moore, professor of physics at the University of Buffalo.

The Adamson lecture was delivered at the University of Manchester on June 9 by Professor Einstein, who had been invited by the council in accordance with a senate recommendation passed on February 3. At the opening of the proceedings the honorary degree of D.Sc. was conferred on him. Professor Einstein lectured on June 13 at King's College, London, on "The development and present position of the theory of relativity." After the public lecture Professor Einstein was the guest of the principal of King's College at a dinner given in the college.

A bronze statue of Joseph Leidy was unveiled in the medical laboratories of the University of Pennsylvania on June 19, 1921. Samuel Murray was the sculptor.

Dr. Marshman Edward Wadsworth, dean emeritus of the school of mines of the University of Pittsburgh, has died at the age of seventy-four years.

The South African Association for the Advancement of Science is meeting at Durban July 11–16, under the presidency of Professor J. E. Duerden, of Rhodes University College, Graham's Town. The sections and presidents are as follows: Astronomy, Mathematics, Physics, Engineering, Dr. J. Lunt, of the Royal Observatory, Cape of Good Hope; Chemistry, Geology, Geography, Dr. J. Moir, chemist to the Mines Department, Johannesburg; Botany, Forestry, Agriculture, Professor J. W. Bews, of Natal University College, Maritzburg; Zoology, Physiology, Hygiene, Professor H. B. Fantham, of University College, Johannesburg; Anthropology, Philology, Dr. C. T. Loram, of the Natal Education Department; Education, Sociology, History, Professor, W. A. Macfadyen, of Transvaal University College, Pretoria.

A standing committee has been appointed within the Department of Agriculture by Secretary Wallace to study the present economic situation of agriculture and make recommendations with respect to any action which might be taken by the department to improve conditions. The committee consists of Assistant Secretary Ball, chairman; Dr. H. C. Taylor, chief of the Office of Farm Management and Farm Economics; Dr. W. A. Taylor, chief of the Bureau of Plant Industry; Dr. John R. Mohler, chief of the Bureau of Animal Industry; and Leon M. Estabrook, associate chief of the Bureau of Markets. The members are gathering data from sources in the Department of Agriculture, and agricultural leaders and economists in various parts of the country will be consulted. They are also making a careful survey of the activities of the department in the field of economics with the purpose of coordinating and strengthening this work.

We learn from *Nature* that at a general meeting of members of the Royal Institution held on June 6 special thanks were given to Sir Humphry Davy Rolleston for his present of a safety-lamp which was in the possession of Dr. John Davy, brother of Sir Humphry Davy, and to Sir David L. Salomons for his present of a privately printed Life and Study of the Works of Breguet, the famous watchmaker, Argo's watch, and two others of spe-

cial interest, the first working aneroid made by Vidi in 1857, and a series of models illustrating the development of the chick.

Baron Edmond de Rothschild, administrator of the Eastern Railway Company of France, has given 10,000,000 francs to found a scientific institute to encourage students to devote their lives to the work of research. The institute will aim to develop science in industry and agriculture. The institute is to be managed by a council, members of which are to be elected by the Academy of Sciences, the College of France, the Faculty of Sciences and the Paris Museum.

The *Journal* of the American Medical Association reports that a new pathological and bacteriological institute has been opened in Prague. There are divisions for pathologic anatomy, experimental pathology, bacteriology and legal medicine. It is popularly called Hlava's Institute, from the name of its chief, Professor Jeroslav Hlava. Dr. Hlava is the senior professor of the staff of the Czech medical school, and is a well known authority on exanthematic fevers. In addition to being president of several medical societies and a corresponding member of the French Academy of Medicine, he is also the president of the Czech Society for Cancer Research. On the day the new building for pathology was opened, the president of the republic made a gift of 100,000 crowns to the Cancer Society for continuing and developing its work.

The importance of regular meteorological reports from Greenland for the forecasting services of Western Europe, and, indeed, for that of Canada also, has, says *Nature,* been recognized for some years. The question of these reports was discussed at the meeting of the International Commission for Weather Telegraphy which was held in London in November last, and the commission decided unanimously that "the establishment at the earliest possible date of a high-power radio-telegraphic station in Greenland is of the utmost importance to the meteorology of Western Europe, and, further, it is of such importance as to warrant the international provision of funds for maintaining it." It is probable that the provision of such a station by the Danish government will be made at an early date. When this station has been provided it will be possible to make a definite use in weather forecasting in Europe of meteorological observations from Canada and the United States. Hitherto the gap between the European and American observations has been so great that meteorologists have been unable to justify the expense which would be involved in regular cable messages from America to England.

The medical division of Stanford University Medical School has received a grant of $300 from the Committee on Scientific Research of the American Medical Association. This money is to be used for the furtherance of an investigation into the factors influencing the rate of urea excretion.

UNIVERSITY AND EDUCATIONAL NEWS

Bequests amounting to $16,624,203 are assured to the medical schools of Harvard, Columbia and Johns Hopkins Universities by the action of Miss Alice A. De Lamar in the Surrogate's Court in waiving her rights to protest the will of her father, Captain Joseph R. De Lamar. The will left more than half of his estate, valued at $33,327,000, to education and charity. The descendant's estate law of New York bars a person from leaving more than half of his estate to charity, without appproval of the heirs.

Dr. G. Canby Robinson, Baltimore, has accepted the post of professor of medicine at the Johns Hopkins Medical School and physician-in-chief of the Johns Hopkins Hospital, to succeed Dr. William S. Thayer. Dr. Robinson is now professor of medicine and dean of the medical faculty of Vanderbilt University, Nashville, Tenn., and expects to return at the end of the year.

Dr. Paul J. Hanzlik, associate professor of pharmacology, school of medicine, Western Reserve University, has been appointed professor of pharmacology in the

school of medicine of Leland Stanford Junior University. Upon his resignation from the medical faculty at Western Reserve, a dinner in honor of Dr. Hanzlik was given at the University Club of Cleveland.

At Oberlin College, Mr. F. E. Carr has been promoted to an assistant professorship of mathematics, and Dr. C. H. Yeaton, of Milwaukee College of Engineering, has been appointed assistant professor of mathematics.

Dr. Paul Thomas Young, of the University of Minnesota, has been appointed associate in psychology in the University of Illinois.

Harry F. Lewis, A.B., A.M. (Wesleyan), Ph.D. (Illinois), at present with the National Aniline and Chemical Company of Buffalo, has been elected associate professor of chemistry at Cornell College, Mount Vernon, Iowa.

DISCUSSION AND CORRESPONDENCE

AN ANALOGY BETWEEN THE THEORIES OF NATURAL SELECTION AND ELECTROLYSIS

1. In a recent reading of the "Origin of Species" I was struck by a marked similarity of the theory, to Clausius's views of the nature of electrolysis. In the latter one begins with ions produced by causes quite outside of the electrical forces. Their presence is a phenomenon on a scale of forces totally beyond the compass of the relatively feeble electric field. They are usually an essentially rare occurrence among molecules. The period of existence of each ion, moreover, is relatively short; but their virtues are at once retrieved, I might say inherited, by the progeny of some other molecule, so that the phenomenon is practically continuous. The familiar result is that the presence of an apparently inadequate field gives us a continuous supply of anions and cations at the electrodes.

2. Now replace ionization by variation, also an essentially independent phenomenon. Consider the positive ion a favorable variation and the negative ion an unfavorable variation. Let the electric field be replaced by natural selection, which embodies a sort of tendency or draft of the same nature as a physical field of force. At least, reciprocally with the individual, it amounts to that, as is evidenced by the term "struggle." Physical forces, moreover, are in a similar way doubly specific. Finally, let the cathode be the goal of survival and let the anode denote extinction. Then the two mechanisms would function in the same way.

3. I have drawn inferences from the model; but these are beyond the mark here. It is merely my purpose to indicate that a mechanism which functions so efficiently in the laboratory, can not under a wider interpretation, fail to function in the economy of nature, and that you have in electrolysis an ocular and approachable demonstration of the result. The thing works. Of course the model represents only an infinitesimal element (as it were) in the continuity of Darwinian evolution. Nevertheless given ionization (however rare among millions of molecules) or an available variation; given also an electrical field (however feeble) or natural selection, you can not have stagnation; irremediably you will have to accept development, appreciable within a period commensurate with the two factors.

Carl Barus

Brown University,
Providence, R. I.

NATIONAL TEMPERAMENT IN SCIENTIFIC INVESTIGATIONS

To the Editor of Science: In Professor Carmichael's paper on "National temperament in scientific investigations" in Science for April 1, 1921, occurs the sentence:

> They (the British) have *no university eager to nurse and develop new talent,* so that the new thinker becomes devoted to nature.

In Merz's "European Thought in the Nineteenth Century," in the first volume, part one, "on the growth and the diffusion of the scientific spirit in the first half of the nineteenth century," we find the statement on page 286:

> The rare genius, gifted with the power of original thought, who found no academy ready to call him, no schools where he could be trained, *no university eager to nurse and develop his talent,* did not retire into the depths of his own

consciousness, or surround himself with the artificial atmosphere of erudition. . . . In England the isolation from society and the solitariness of genius threw him into the arms of Nature. . . .

Again on page 276:

But it is a fact that no Academy existed in this country which was zealous in collecting and arranging all the best labours of scattered philosophers, no university which was anxious to attract and train promising intellects. . . .

Most of the phrases in Professor Carmichael's paragraph on British science and also in the paragraph contrasting the temperaments of the three European nations will be found in this chapter of Merz's on pages 250, 252, 279, 281 and 300.

I wish to point out that what Merz wrote in 1896 about English science and English universities in the first half of the nineteenth century does not necessarily apply to British science and British universities at the present time. As Merz remarks on page 300:

During the second half of the century a process of equalisation has gone on which has taken away something of the characteristic peculiarities of earlier times. The great problems of science and life are now everywhere attacked by similar methods. Scientific teaching proceeeds on similar lines, and ideas and discoveries are cosmopolitan property.

Whether or not this is a fact, and whether or not, if it is a fact, the final paragraphs of Professor Carmichael's paper are sound, I do not pretend to judge. But I do protest that the statement that the British have no university eager to nurse and develop new talent is not true to-day, even if it was true in 1850.

It may also be proper to note that Merz's statement definitely applies to *English* rather than to *British* universities; and on page 271 the Scottish universities of that day are contrasted with their English sisters.

J. W. Clawson

To the Editor of Science: The criticisms of my article on "National temperament in scientific investigations," offered by Mr. J. W. Clawson, are essentially the following two: It is implied that I have made an improper use of Merz's "European Thought"; it is claimed that I have been unjust to the British in a certain particular. I appreciate the opportunity to say a word about them.

With respect to the first of these I prefer to leave it to the reader, who makes the comparison between the two paragraphs named by Mr. Clawson and the passages in Merz referred to by him, to determine whether my practise is justifiable, calling his attention to the fact that the statements in one of these paragraphs were given as what seemed to me to be "the impartial verdict of history" rather than as an expression of judgment independently formed by me.

With regard to the question of injustice to the British I have the following to say: The main burden of my paper was to urge upon my own countrymen the desirability of realizing in their own scientific activity the characteristics of spontaneity and individuality which have particularly marked the work of the British and which have led (as it was pointed out) to a greater fruitage of the larger things among them than has fallen to the lot of any other people; in the particular (and somewhat unfortunate) phrase criticized I had no intention to say anything particularly harmful to the British nor had I supposed that I had done so; one of my correspondents has expressed his pleasure in what he was pleased to call my just emphasis of the value and importance of the British methods and results; Mr. Clawson now appears to think that I am quite unjust to the British (at least in a certain particular); another has already belabored me for being unjust to the Germans; if still another shall accuse me of a like injustice to the French, I shall begin to think that I have held a fair balance among the three nations in my attempt to point out certain values realized by them which I wish to see attained by the scientists of America in fuller measure in the future than in the past.

R. D. Carmichael

University of Illinois

SPECIAL ARTICLES

THE PREDICTION OF THE PHYSIOLOGICAL ACTION OF ALCOHOLS[1]

COMPARATIVELY few laws are known connecting the chemistry of various substances with their physiological effects; such a condition is natural because of the complexity of many of the compounds used in therapeutics. In seeking for generalizations it is therefore advisable to direct our attention at first to compounds possessing rather simple structures.

In connection with the testing of the toxicity of various normal primary alcohols upon *Paramecia* the writer noticed the almost quantitative application of a simple numerical rule. Methyl alcohol, as was expected from its structure, exhibited an abnormality, but beginning with ethyl alcohol and expressing its action as *unity* the acute toxicities of the successive members subjected themselves to numerical expression, particularly when the quantity of alcohol used was expressed in moles and not in grams.

In an homologous series of this kind the molar toxicity of any given member is three times that of the preceding member. The rule is expressed numerically by the geometrical progression:

$$1 : 3 : 3^2 : 3^3 : 3^4 : 3^5 \ldots .$$

The value of this generalization, originally presented by Traube on the basis of surface tension experiments, lies in the fact that it may be apppplied not merely to unicellular organisms, but to mammals as well. Its application is shown best by a few examples.

EXAMPLE I

The toxic concentration of ethyl alcohol for a given strain of paramecia was found by experiment to be 4.5 per cent. What concentration of *n*-octyl alcohol will prove equally toxic to the same strain of organisms?

Solution: $1 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 729.$

$$\frac{4.5\% \times 2.8^{*\,2}}{729} = 0.02\% = \text{calculated concentration.}$$

The observed value was found to be 0.03 per cent.

[1] Article No. 4, Chemical Research Department, Parke, Davis & Co.

EXAMPLE II

If a mouse is killed within a few hours by intraperitoneal administration of 12 mg. of ethyl alcohol per gram of body weight, what will be the corresponding toxic dose of *n*-amyl alcohol?

Solution: $1 \times 3 \times 3 \times 3 = 27.$

$$\frac{12\text{ mg.} \times 1.9^*}{27} = 0.84\text{ mg.}$$

The observed value was found to be very close to 1.0 mg. per gram of body weight.

EXAMPLE III

The toxic dose of ethyl alcohol when injected into the blood stream of the cat was found by Macht[3] to be 5.0 c.c. per kilo. The administration time was 50 minutes. Under exactly similar experimental conditions what will be the toxic dose (*a*) of *n*-propyl alcohol, (*b*) of *n*-amyl alcohol?

Solution: (*a*) $1 \times 3 = 3.$

$$\frac{5.0\text{ c.c.} \times 1.3^*}{3} = 2.17\text{ c.c.}$$

$$= 2.14\text{ c.c. corrected for sp. gr.}$$

The experimental value was found by Macht to be 2.0 c.c., although in this case the toxic amount of liquid was administered during 20 minutes.

Solution: (*b*) $1 \times 3 \times 3 \times 3 = 27.$

$$\frac{5.0 \times 1.9^*}{27} = 0.35\text{ c.c. (uncorrected for sp. gr.).}$$

The experimental value was found to be 0.15 c.c., which is a very satisfactory result in view of the fact that the toxic material was administered during seven minutes. When administered over an interval of from 30 to 50 minutes the observed value would no doubt approach the calculated value.

A more detailed discussion of the present work is appearing in a series of reports in the *J. Am. Pharm. Association.*

OLIVER KAMM

[2] The values marked with the asterisk are molecular weight ratios which serve to convert the predicted values from moles to grams.

[3] *J. Pharmacol.*, 16, 1 (1920).

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF ORGANIC CHEMISTRY

(*Continued*)

Symmetrical tribromphenylpropiolic acid and its reaction with acetic anhydride: ROBERT CHAMBERS. Phenylpropiolic acid condenses with acetic anhydride to form a phenylnaphthalene dicarboxylic anhydride. This reaction holds for derivatives of phenylpropiolic acid where there is a free ortho hydrogen. It was desired to investigate the action of acetic anhydride on a di ortho substituted phenyl propiolic acid. The above acid was prepared from meta nitro cinnamic acid as follows: reduction with zinc and hydrochloric acid gave meta amido hydrocinnamic acid. Bromination and subsequent diazotization in boiling ethyl alcohol gave 2.4.6 tribromhydrocinnamic acid. Heating to 145° in a sealed tube with bromine gave αα dibrom 2.4.6 tribromhydrocinnamic acid. The latter with hot alcoholic potash gave 2.4.6 tribromphenylpropiolic acid. With acetic anhydride the above acid does not condense to a phenylnaphthalene derivatives but forms an anhydride which may be hydrolyzed to the original acid.

The reactions of alpha anthroquinonesulfonic acids with mercaptans: E. EMMET REID, COLIN M. MACKALL and G. E. MILLER. Sodium anthroquinone-alpha-monosulfonate and the 1.5 or 1.8 disulfonates react readily with mercaptans in water solution to replace the sulfonic acid group by —SR to give anthraquinone alkyl thio-ethers or dithio-ethers, α-$C_{14}H_7O_2.SR$, 1, 5-$C_{14}H_6O_2(SR)_2$ and 1.8-$C_{14}H_6O_2(SR)_2$. The disulfonates may give the intermediate alkyl thio-ether sulfonate.

The polymers of pinene: G. B. and C. J. FRANKFORTER and E. R. KRYGER.

Contribution to our knowledge of the chemistry of calcium carbide: G. B. FRANKFORTER and A. E. STOPPEL.

A new lactone from oil of orange: FRANCIS D. DODGE. Essential oils of citrus species, obtained by expression, on standing generally deposit solids from which certain lactones derived from coumarin have been obtained. In the present communication is described a new lactone of rather unusual properties obtained from the sediment of West Indian oil of orange. It forms colorless needles (m. p. 88–90°) easily soluble in alcohol and ether, slightly so in ligroin. Optical rotation is about —38° in alcohol. On acidifying an alkaline solution it yields a crystalline acid (m. p. 151°) from which no crystalline salts could be obtained. It yields no acetyl derivative, and can not be reconverted into the lactone. It is readily oxidized by permanganate. The lactone, like coumarin, yields a crystalline compound with bisulfite. Analysis indicates the empirical formula: $C_{16}H_{18}O_3$.

The bromination of 2-amino-p-cymene: ALVIN S. WHEELER and IRA W. SMITHEY. Pure p-cymene, obtained from spruce turpentine, was nitrated and the 2-nitro-p-cymene was reduced with Sn and HCl. The acetyl derivative of 2-amino-p-cymene in CCl_4 solution was boiled with bromine. Bromo derivative, needles, m. 122°; yield 60 per cent. Hydrolysis gave free amine, liquid, b. 169°–170° at 20 mm., d_4^{21} 1.3012, n_D^{20} 1.5781. HCl salt, plates, m. 206°–210°. HBr salt, plates, m. 205°. Diazobromoaminocymene, canary yellow needles, m. 146°–148° (decomp.). Oxidation of bromoacetylaminocymene with neutral permanganate gave a toluic acid derivative, m. 213°. Hydrolysis with acid gave the bromoamino acid, needles, m. 151°; HCl salt, plates, m. 190° (decomp.). No bromoamino toluic acid of this description could be found in the literature. The Br atom appears to be in the 3 position.

New derivatives of 2, 3, 8-tribromo-5-hydroxy-1, 4-naphthoquinone: ALVIN S. WHEELER and T. M. ANDREWS. Action of NaOH on the tribromoquinone (*A*) gave the 2, 3-dibromo-5, 8-dihydroxy-1, 4-naphthoquinone (*B*), which, reduced with Zn and H_2SO_4, gave 2, 3-dibromo-1, 4, 5, 8-tetrahydroxynaphthalene, greenish needles, m. 164°–166°. Tetracetyl derivative, yellow needles, m. 149°–150°. Acetyl derivative of *B*, yellow prisms, m. 197°. Methyl ether of *A*, yellowish red plates, m. 209°–210°. Ethyl ether of *A*, yellow needles, m. 134°–136°. Aniline derivative of *A* (Br No. 8 replaced), purplish chip-like crystals, m. 235°. *A* is converted by Zn and H_2SO_4 into the trihydroxy derivative, yellowish needles, m. 106°–107°; triacetyl derivative, colorless prisms, m. 220°. Br. No. 8 in *A* is replaced by Cl with HCl and alcohol, golden bronze plates, m. 152°; acetyl derivative, yellow prisms, m. 160°. Ketone reagents on *A* do not give well defined products.

The bromination of 2-amino-p-cymene: ALVIN S. WHEELER and I. W. SMITHEY. (By title.)

The production of furfural by the action of superheated water on aqueous corn cob extract: F. B. LAFORGE. (By title.)

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

C. E. Coates, *chairman.*
T. J. Bryan, *secretary.*

Suggestions for more rapid and exact methods of analyses for the cheese factory: S. K. ROBINSON.

Some problems of the pure food manufacturer: H. A. NOYES. The preserver of fruit and fruit products has two important problems to solve: (1) The obtaining of a high quality and uniform fruit supply each year, and (2) the processing of fruit in such a way that its natural properties are retained. The pure food manufacturer's inability to accomplish these two things up to the present has allowed the artificial flavor and color manufacturer to develop his products and befuddle the taste of the average consumer. The plans and organization of one large concern, to study the production of quality fruits and to apply research methods to its business, were given.

Variations in the Concord grape during ripening: H. A. NOYES, H. T. KING, J. H. MARTSOLF. Variations in the Concord grape during ripening that are of interest to the juice and jam manufacturer were investigated. Results show a gradual increase in sugar content, a decrease in total acids and irregularities in tannin and coloring matter. Weather conditions were an important factor affecting sugar content, warm days and cool nights seeming to be the optimum condition for developing sugar.

The absorption of copper from the soil by potato plants: F. C. COOK. Insoluble copper compounds present in a Bordeaux spray containing an excess of lime and present in Pickering spray containing no excess of lime, also a solution of sulfate of copper, were added to the soil near the roots of potato plants in equal strengths and amounts at various intervals during the growing season. Samples of vines, tubers and soil were taken for analyses at frequent intervals. The leaves of the plants grown in the soil receiving the insoluble copper, *i.e.,* the sprays, held the largest part of the copper, the roots but little and the stems an intermediate amount. The tubers contained but traces of copper. Where the soil was treated with the copper sulfate solution the roots were injured and the normal metabolism of the vines interfered with. The tubers from these vines were small and the vines stunted. In these plants the roots held more copper than the leaves. The soluble copper sulfate added directly to the soil caused injury to the plants while the insoluble copper compounds of the sprays did not. The extra lime of the Bordeaux spray did not reduce the amount of copper absorbed by the plants compared with the results on the Pickering plants. Where the sprays and copper sulfate solution were added to the soil directly practically the same amounts of copper were recovered from the soil samples. Samples of soil from sprayed potato fields showed but minute amounts of copper.

Pickering Bordeaux sprays: F. C. COOK.

Analysis of the Jerusalem artichoke: A. T. SHOHL. The Jerusalem artichoke, *Helianthus tuberosus,* gives the analysis:

	Water	N×6.25	Fat	Carb.	Fiber	Ash
Per cent...	79.0	3.1	.2	16.5	.8	1.1

The wastage by peeling is 31 per cent., the hydrogen ion concentration (colorimetric) pH 5.0. The carbohydrate is inulin, as determined by polariscope and quantitated after inversion by Benedict's solution. Experiments show it is utilized, and not excreted by diabetics. The nitrogen is largely extracted with boiling water. This non-protein fraction represents 71.5 per cent. of total nitrogen. Of the water soluble non-protein nitrogen 26 per cent. is free amino acid nitrogen and 12 per cent. ammonia nitrogen.

Measuring soil toxicity, acidity and basicity: R. H. CARR.

What puts the "pop" in pop corn? R. H. CARR. (Lantern.)

The rate of oxidation of lime-sulfur: C. A. PETERS and A. L. PRINCE. The rate of oxidation of lime-sulfur is largely independent of the concentration and also of the temperature up to about 80°, when the rate is increased in all but the very dilute solutions.

A color test for "remade" milk: OSCAR L. EVENSON.

Effect of aging on lecithin-phosphoric acid determination of egg noodles: R. C. HUMMELL. The results of these experiments indicate that aging does have considerable effect on the lecithin-phosphoric acid determination in egg noodles. By the end of six months this value had decreased to less than two thirds of the original value and in eighteen months had decreased to one half or less than one half of the original amount. Inasmuch as considerable time may elapse from the time at which egg noodles are manufactured until they reach the consumer, it would seem to be quite in

error to judge the egg content by the value obtained in the aforesaid determination.

Peanut by-products: J. B. Reed.

Some factors governing the crystallization of lactose in ice cream: Harper F. Zoller and Owen E. Williams. A curve is presented as a result of experimental evidence which serves to separate those mixes which will produce sandiness from those which will not, and is based upon the relationship existing between the protein-serum solids concentration and the concentration of lactose within the mix. It is erroneous to calculate the concentration of lactose on the water basis since the total water in the mix is not available to the lactose because of the competition of the other solids. The effect of the proteins within the mix is not to repress the crystallization of lactose, but they act oppositely in increasing concentration. Because of its slow rate of crystallization lactose hydrate is subject to much supercooling and oversaturation. Protein has very little effect upon its rate of growth. The solubility of lactose hydrate according to the best of experimental deductions is 11.15 per cent. at 0° C. In an ice cream mix containing 10 per cent. fat, 14 per cent. of cane sugar and 65 per cent. of water, the above value for lactose reduces to about 8.9 per cent. calculated on the water basis.

A rotating thermocouple and cold junction designed for temperature studies in horizontal power ice cream machines: Harper F. Zoller. A sensitive and experimental thermocouple is described and illustrated which has been designed for the purpose of accurately measuring the temperature of the ice cream mix within the freezer when the latter is rotating at full speed. By maintaining an ice-water cold junction affixed to the shaft of the freezer along with the thermocouple junctions the small temperature differences within the freezer can be measured with an accuracy of .02° C. This latter is also made possible by the use of a five junction copper-constantan thermocouple (of fine wire for small temperature lag effect) and a potentiometric setup embracing a galvanometer of low internal resistance with a potentiometer of microvolt capacity. The unique feature of the instrument is the method of conducting the small e.m.f. from the rapidly rotating shaft to the potentiometer without frictional thermoelectric effects. The instrument has been in regular service for a number of months, has given no trouble, and has measured the rapidly fluctuating temperatures within the mix simply and accurately.

Cases of supercooling during the freezing of ice cream mixes: Harper F. Zoller and Owen E. Williams. By the use of the rotating thermocouple we have examined the point of separation of ice in a variety of mixes. The measurements were made in a commercial ice cream machine of the Miller type with a capacity of five gallons. The freezing point lowering of the mix was not in harmony with the calculated value, but showed a high supercooling in the mix even in the presence of the swiftly moving beaters and scrapers. The addition of fine particles of substances to promote the formation of crystal nuclei prevented the supercooling of the mix and consequently the freezing was done in a shorter time, and the product was smoother. Both fat and gelatin seem to reduce supercooling in the average mixes. When sand is added to an ice cream mix containing 10 per cent. fat and 0.5 per cent. of gelatin ice begins to separate at only a slightly higher temperature when the brine is at 10° F. during the freezing process. If the brine is much lower there is a greater difference in the supercooling effect when no sand is present in the above mix. When mixes are frozen which have been made from evaporated milk containing lactose crystal nuclei and they have not been destroyed by pasteurization, or other means, no supercooling occurs. A great deal of importance is attached to the degree of supercooling and its influence upon the texture of the ice cream as it comes from the freezer.

Black discoloration in canned sweet potatoes: Edw. F. Kohman. The black discoloration which occurs in canned sweet potatoes begins in the bottom of the can where there is usually a semiliquid starch paste which affords close contact with the can. Eventually it may penetrate the entire content of the can. The black formation is due to the combination of iron dissolved from the can with a tannin-like substance in the potatoes. This is localized to a considerable extent just beneath the peel. But as there is also some throughout the potato and especially about the center no change in present methods of peeling would be of advantage. Tannins do not form black compounds with iron unless the latter is in its highest state of oxidation. As air is essential to bring it into this condition, the necessity of tight seams in canned sweet potatoes is emphasized.

Charles L. Parsons,
Secretary

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CONTENTS

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TYPES OF VALENCE

FROM the theory proposed by G. N. Lewis in 1916 and subsequently extended by the writer, it is clear[1] that the term valence has been used in the past to cover what we may now recognize as three distinct types of valence, viz.:

1. Positive valence: the number of electrons an atom can give up.
2. Negative valence: the number of electrons an atom can take up.
3. Covalence: the number of pairs of electrons an atom can share with its neighbors.

It was shown that these fundamental conceptions of valence as well as the actual numerical values of each type of valence for most of the elements could be derived from a few postulates regarding the structure of atoms. The following method of deriving these relationships, however, is not only much simpler than that previously given by the writer, but throws a new light on the relationships between the different types of valence.

We will take for granted the Rutherford type of atom, which consists of a positive nucleus surrounded by a number of electrons equal to the atomic number of the atom. We will also assume that Coulomb's law applies to the forces between the charged particles in the atom, but at the same time will recognize the existence of repulsive forces in atoms which prevent the electrons from falling into the nucleus. For the present purpose, however, it is immaterial whether the repulsive force is a dynamic force (centrifugal force) such as that assumed by Bohr, or is a static force as postulated by G. N. Lewis, J. J. Thomson or recently by the writer.[2]

We shall need to make only 3 postulates in

[1] Langmuir, *Jour. Amer. Chem. Soc.*, 41, 926 (1919), and *Jour. Ind. Eng. Chem.*, 12, 386 (1920).

[2] SCIENCE, 53, 290, Mar. 25, 1921.

regard to the structure of atoms, and these are consistent with those previously proposed.

Postulate 1.—The electrons in atoms tend to surround the nucleus in successive layers containing 2, 8, 8, 18, 18 and 32 electrons respectively.

The word atom is used in the broader sense which includes charged atoms (ions). If the number of electrons in an atom is such that they can not all form into *complete layers* in accord with Postulate 1, the extra electrons remain in the outside layer as an *incomplete layer* which we may designate as the *sheath* of the atom. Every electrically neutral atom must contain a number of electrons equal to the atomic number of the nucleus. If the outside layer of such an atom is nearly complete, the tendency expressed by Postulate 1 may cause a few additional electrons to be taken up in order to complete the layer, thus forming a negatively charged atom or ion. In such a case we may say that the sheath has been completed.

In the following discussion it is important to keep in mind this distinction between sheath and outside layer. Every incomplete outside layer which occurs normally is a sheath, but a complete outside layer may or may not be a sheath. The following definition will make this clearer. *The sheath of any atom (or atomic ion) consists of all the electrons in the outside layer provided that this layer is incomplete when the atom is electrically neutral.* Thus atoms of the inert gases (neon, argon, etc.) and ions such as Na^+, Ca^{++}, etc., have *no sheaths* for the outside layers of these atoms consist of electrons which already form a complete layer in the neutral atom. The sodium *atom,* however, has an *incomplete sheath containing* one electron, while the fluorine atom has an incomplete sheath of 7 electrons. The fluorine *ion,* on the other hand, has a *complete sheath* of 8 electrons.

The inert gases are the only elements whose neutral atoms have no sheaths, or in other words have all their electrons arranged in complete layers in accordance with Postulate 1. In all other atoms, the tendency expressed by this postulate can only be satisfied by an interaction between atoms involving a rearrangement of the electrons. This is to be regarded as the fundamental cause of chemical action and it is by such interaction that chemical compounds are formed.

When as the result of such rearrangement of electrons, the sheath of an atom has become complete, we may speak of the atom as a *complete atom.* Similarly if the interaction between atoms leads to complete satisfaction of the tendency of Postulate 1, so that all the atoms become complete, we may say that a *complete compound* is formed. We shall see that there are some factors which may oppose the formation of complete atoms and counteract the tendency of Postulate 1. In such cases incomplete atoms and compounds may result.

According to Postulate 1, the first complete layer in any atom consists of two electrons close to the nucleus. Let us call this stable pair of electrons a *duplet* and let us broaden the definition of duplet to include any pair of electrons which is rendered stable by its proximity to one or more positive charges. We may now state the second postulate.

Postulate 2.—Two atoms may be coupled together by one or more duplets held in common by the completed sheaths of the atoms.

Let us now analyze the conditions that must be fulfilled if the interaction between atoms is to result in the formation of a complete compound.

A given group of neutral atoms may interact to complete their sheaths in two ways:

1. *By transfer of electrons.*
   a. Atoms having sheaths containing only a few electrons may give up these extra electrons to other atoms.
   b. Atoms having nearly complete sheaths may take up electrons from other atoms.
2. *By sharing duplets.*
   Atoms may share duplets with other atoms (Postulate 2) and thus complete their sheaths with fewer elec-

trons than would otherwise be necessary.

Let e be the number of electrons in the sheath of any neutral atom and let s be the number of electrons in the sheath after the atom has interacted with others. For the atoms of any complete compound the values of s can be only 0, 2, 8, 18 or 32.

In any group of atoms, the only electrons available for the formation of the complete sheaths are those which originally form the incomplete sheaths. The number of such electrons, $\Sigma(e)$, is found by adding the values of e for the individual atoms. In the resulting compound, if no duplets are shared by the atoms, the total number of electrons in the complete sheaths is $\Sigma(s)$. Every duplet held in common by two atoms, however, decreases by two the number of electrons required to form the sheaths. If then we let B be the total number of duplets shared within the given group of atoms, the number of electrons in the completed sheaths of the atoms of the compound is $\Sigma(s)-2B$. Since this must equal the number in the original neutral atoms, we have the relation [3]

$$\Sigma(e)=\Sigma(s)-2B. \qquad (1)$$

This is the condition for the formation of a complete compound. We shall now proceed to put this equation into a simpler form and one which has more significance to the chemist.

The transfer of electrons that may occur during the interaction between atoms corresponds to what has been called positive and negative valence while the sharing of duplets corresponds to covalence. We shall see that the positive and negative valence differ from one another fundamentally only in algebraic sign, so that we shall find it convenient to include both positive and negative valence under the term *electrovalence,* which we may designate by the symbol v_e. We shall then adopt the convention that the electrovalence of an atom is positive when the atom gives up electrons and negative when it takes up electrons. The *electrovalence* of an atom in any compound may thus be defined as the number of electrons which the neutral atom must give up in forming that compound. If the neutral atom must *take up* electrons, the electrovalence is expressed as a negative number. The electrovalence of any atom is thus given by the expression

$$v_e=e-s. \qquad (2)$$

Electropositive atoms in complete compounds lose all the electrons in their sheaths so that s is zero and therefore v_e is positive and equal to e. For electronegative atoms s is always greater than e so that v_e is negative.

Let us define the *covalence* (v_c) of an atom as the number of duplets which that atom shares with neighboring atoms. Every duplet shared by two atoms corresponds to a (covalence) *bond* between atoms, and we have already represented the number of such bonds in a given group of atoms by the symbol B. If we now form $\Sigma(v_c)$ by adding the values of v_c for all the atoms in the given group, we count each bond twice. Hence we may place

$$\Sigma v_c=2B. \qquad (3)$$

By substituting (3) and (2) in (1) and rearranging terms we find

$$\Sigma v_e+\Sigma v_c=0. \qquad (4)$$

This simple result may be stated as follows:

The sum of the electrovalences and covalences for all the atoms in any complete compound is zero.

Electrovalence and covalence are thus in a sense supplementary to one another. If we represent v_e+v_c by v, Equation 4 takes the form

$$\Sigma v=0 \qquad (5)$$

for any complete compound, and this suggests that the quantity v may have some simple physical significance.

In accordance with the nomenclature introduced by Lewis we may define the *kernel* of an atom as that part of an atom which re-

[3] Equation (1) is a more general statement of the relation $e=8n-2p$ which has been used previously by the writer in discussing the "octet theory."

mains after the sheath is removed. Since the neon atom has no sheath the whole atom constitutes a kernel with zero charge. The kernel of the sodium atom is the sodium ion with single positive charge, while the kernel of the fluorine atom (or fluorine ion) consists of the nucleus and two electrons, the whole having 7 positive charges.

Since the sheath of any neutral atom consists of e electrons, the positive charge on the kernel is also e. In any complete atom there are s electrons in the sheath. When the atom does not share duplets with other atoms (covalence zero) then the total charge of the atom is $e - s$. If, however, any two atoms hold a duplet in common the total charge of the two atoms is decreased by two units. *If the two atoms are substantially alike in size and structure,* we may assume that this decrease in charge is to be divided equally between the two atoms. Thus if an atom in a compound has s electrons in its sheath and it has a covalence v_c then the effective charge of its sheath is $s - v_c$. The total charge of the atom may thus be taken as

$$e - (s - v_c) = v_e + v_c = v.$$

Thus v, the sum of the electrovalence and the covalence, for any atom in a compound, is equal to the *residual atomic charge.*

When two atoms which hold a duplet in common differ considerably in size, it is no longer obvious that the two electrons of the duplet should be divided equally between the two atoms in determining the residual charge. We may, however, arbitrarily so define the boundaries of the individual atoms in molecules that a duplet binding two atoms together is to be regarded as belonging equally to the two atoms. In this case we may consider v to be the residual atomic charge even when the atoms differ greatly in size.

It is evident from Coulomb's law that the separation of positive from negative charges requires in general the expenditure of work. The most stable forms of matter should be those in which the positive and negative charges are as near together as possible. However, we can not rely entirely upon Coulomb's law for this would indicate that the distance between unlike particles should decrease without limit. The exact distribution of charged particles in their most stable arrangement thus requires a knowledge of the repulsive forces whose existence we have already assumed. A further discussion of this point will be reserved for a future paper. At present we may attempt to express this relation by the following postulate.

Postulate 3.—The residual charge on each atom and on each group of atoms tends to a minimum.

By "residual charge" is meant the total charge of an atom or group of atoms regardless of sign. By "group of atoms" is meant any aggregate of atoms which are characterized by proximity to one another. It is felt by the writer that this postulate is a crude expression of a very important and fundamental law. When we understand the repulsive forces between charged particles better we shall be able to state the law in a more nearly quantitative form. The law is of very wide application. The uniformity of distribution of positive and negative ions in a salt solution is a familiar example of the working of this law. In any small finite element of volume the charges of the positive and negative ions tend to be very nearly equal or the residual charge tends to a minimum.

Postulate 3 expresses merely a strong *tendency* so that in general the charges of individual atoms are not necessarily zero. When the atomic charges depart from zero, however, they do so only as the result of a definite force or action which opposes the tendency of Postulate 3. We shall see that Postulates 1 and 3 are often in conflict and in such cases the tendency of Postulate 1 may prevail against that of Postulate 3.

We may now classify chemical compounds according to the types of valence exhibited by their atoms and will consider the application of Postulate 3 to each class of compound. There are 3 general subdivisions to consider: (1) Complete Compounds, (2) Incomplete Compounds, and (3) Exceptional Cases.

1. Complete Compounds.—All electrons are

in complete layers of 2, 8, 18 and 32 electrons, in accordance with Postulate 1. Since Σv_c in Equation 4 can never be negative, Σv_e must always be either zero or negative. Therefore atoms having negative valences must always be present in a complete compound. Thus electropositive elements do not form complete compounds with each other.

a. Compounds Without Covalence.—$\Sigma v_c = 0$. Equation 4 becomes $\Sigma v_e = 0$, so that the sum of the negative valences in the compound must be the same as the sum of the positive valences. Since the residual charge v for each atom must equal $v_e + v_c$ it is evident that compounds without covalence must consist of positively and negatively charged ions. The charge v on each ion of complete compounds of this type is uniquely determined by the values of e for the elements forming the ion. This is a case where Postulates 1 and 3 are in conflict. The tendency of Postulate 3 by itself would make each atom electrically neutral, but this would leave the sheaths of the atoms incomplete and so fail to satisfy the tendency of Postulate 1. The result is a kind of compromise by which Postulate 1 may be satisfied by the formation of complete compounds *provided this can take place without the charges on the ions becoming too large.*

Although Postulate 3 does not definitely fix the charges of the individual atoms in the compounds we are considering, yet it does determine the distribution of these ions in space. This is a factor of prime importance in the crystal structure, in the electrolytic conductivity of substances when in the liquid state, and in other properties. It is also the cause of an interesting effect observed when the number of ions of one sign is much greater than that of the other sign, as for example in such compounds as $AlCl_3$, PCl_5, SF_6, etc. Postulate 3 requires that the negative halogen atoms in these compounds shall surround the most strongly positive atoms. The ions thus form groups having strong internal and weak external fields of force so that these constitute molecules of considerable stability and inertness towards outside influences. The volatility of these substances and the absence of electrolytic conductivity are due to this cause.

Typical examples of complete compounds without covalence are:

Salts.—When the atomic charges are small as in NaCl, $BaBr_2$, K_2S, etc., the salts are fairly readily fusible, soluble in liquids of high dielectric constant, good electrolytic conductors when molten or in solution and very difficultly volatile. With larger charges as in MgO, BN, Al_2O_3, etc., the strong forces give great infusibility, insolubility, hardness, etc., to the substance. Such compounds are exceptionally good electric insulators at moderate temperatures but are electrolytic conductors when molten.

Silicates, glasses, slags, complex sulfides, and most minerals, etc., are compounds which usually contain several electropositive elements. In the molten, and often in the solid condition, they are electrolytic conductors and are usually soluble in one another. The valence relation $\Sigma v_e = 0$ gives us no information in regard to the structure; for example, we can not write structural formulas for such compounds. The definite composition of many solid minerals, etc., is largely due to the regularities of the space lattices of their crystals.

Volatile halogen compounds such as AlF_3, PCl_5, SF_6, and structurally related complex ions such as SiF_6^{--} in the compound K_2SiF_6. Such high electrovalences as $+5$ for phosphorus, and $+6$ for sulfur can occur only when the tendency of Postulate 3 is counteracted by a particularly strong opposing tendency. In the case cited above it is the exceptionally great affinity of the halogen atoms for electrons that causes the action. The halogen atoms have this property in marked degree because they have larger charges on their kernels than other atoms and therefore exert a greater attraction on electrons (Coulomb's law). The fluorine atom has a greater affinity for electrons than the other halogen atoms since the radius of the atom is less and the force (by Coulomb's law) acting on the electron is greater.

b. Compounds Without Electropositive

Atoms.—In these compounds the electrovalence of *every atom* must be negative, for if the electrovalence of any element is zero (inert gases) it can form no compounds. If we let v_n represent the numerical value of the negative valence we obtain from Equation 4

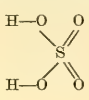
$$\Sigma v_c = \Sigma v_n. \qquad (6)$$

Since $v_n = s - e$, the value of v_n is fixed for any particular atom. For any given group of atoms, we can find Σv_c from (6) but we can not find the values of v_c for the individual atoms, in this way.

If, however, we place $v_c = v_n$ for each atom it is evident that Equation 6 will be satisfied. The residual charge on every atom (being $-v_n + v_c$) is then zero. Thus in any group of atoms *Postulates 1 and 3 are both completely satisfied if the covalence of each atom is equal to the negative valence of that atom.* The negative valence of carbon, nitrogen, oxygen and sulfur are 4, 3, 2 and 2 respectively, while that of hydrogen and the halogens is one. If therefore we follow the custom of the organic chemist and write structural formulas using these valences we obtain results in complete accord with Postulates 1, 2 and 3.

Thus these 3 postulates lead us to a rational derivation of the empirical valence rules which constitute the foundation of the science of organic chemistry. Moreover we are brought to see clearly the limitations of this empirical theory. We now realize that it is only *negative* valences that should be used in structural formulas (*i.e.*, as covalences) and that even these can only legitimately be used in compounds in which electropositive atoms are entirely absent, for if some of the atoms have a positive residual charge ($v = v_e$) then from Eq. 5 it is evident that other atoms must have a negative charge, and for these as well as the electropositive atoms the covalence is not equal to the negative valence.

From this viewpoint it is incorrect to write structural formulas such as Na—Cl,


,

etc., in which the covalence of one atom is taken as equal to the positive valence of that atom.

It should be kept in mind that Postulate 3 does *not require* that v_c should be equal to v_n. There is merely a tendency for these valences to be equal. Among compounds of electropositive elements we saw that there was a conflict between the tendencies of Postulates 1 and 3 so that v was always different from zero. With compounds formed exclusively of electronegative atoms, however, there is not necessarily a conflict and it is for this reason that we have such a large class of compounds in which v is zero (*i.e.*, $v_c = v_n$). There may be various causes that make it difficult for v to be zero even for some compounds of electronegative elements, so that in individual cases v may differ from zero by one or two units. It must be remembered that we deduced the relation $v = minimum$ from Postulate 3 only by assuming the two atoms which share a duplet are of substantially the same size, etc. From Coulomb's law we should expect that either a large charge on the kernel of an atom or a small radius for the kernel should cause electrons in the sheath to be held more firmly and should make it easier for the atom to acquire a negative residual charge. As an example let us consider the electronegative elements of the first two periods.

As we pass from carbon, through nitrogen and oxygen, to fluorine, the kernel charge increases and the size of the kernel presumably decreases. The residual atomic charge should thus tend to become more negative as we pass towards fluorine and more positive in comparison as we pass towards carbon. In other words, in compounds of these elements, we should expect a tendency for fluorine to have a covalence a little less than its negative valence while for nitrogen the covalence should tend to be greater than the negative valence. Since there are only eight electrons in the sheath of these atoms, the covalence of the carbon atom can never exceed four. All these conclusions are in perfect accord with experience. Thus we find the following covalences:[4]

Carbon	*4*	(3)			
Nitrogen	4	*3*	(2)		
Oxygen		(3)	*2*	1	0
Fluorine				1	*0*
Silicon	4 (or electro-positive)				
Phosphorus	*4*	3			
Sulfur	4	3	2	1	0
Chlorine	(4)	(3)	(2)	*1*	*0*

In this table the numbers in italics give the most common valences, while those in parentheses are only rarely found. It is clear that a large kernel charge favors covalences less than the negative valences while a small kernel charge has the opposite effect. A comparison of the elements of the second period with those of the first, shows a slight tendency for larger covalences among the heavier elements. This is to be explained as the effect of the larger kernel and hence weaker forces. There is also much more scattering among the valences of the heavier elements. This is another result of the weaker forces acting on the electrons for the covalence of such atoms is more dependent upon the electron affinity of the other atoms with which they are combined.

As an example of these relationships, let us consider the compounds, CH_4, NH_3, H_2O, and HF. In each atom of these compounds the covalence is equal to the negative valence so that the residual charge is zero and the tendencies of Postulates 1 and 3 are satisfied. If we mix the NH_3 and HF together the larger kernel charge of the fluorine as compared with the nitrogen, gives a tendency for the fluorine atom to become negative at the expense of the nitrogen. Thus the covalence of the fluorine decreases to zero while that of the nitrogen increases to four. This leads to the formation of the compound NH_4F which consists of NH_4^+ ions and F^- ions. The total number of covalence bonds has not been changed, they have merely been distributed differently. But this causes the atoms to become charged and makes the compound an electrolyte. It should be noted that this theory indicates definitely in what direction the change of charge occurs. Thus we should not expect NH_3 and HF to give a compound consisting of ions NH_2^- and H_2F^+ although under other conditions these ions might exist.

[4] See Langmuir, *Jour. Amer. Chem. Soc.*, 41, 927 (1919).

Similarly NH_3 and H_2O may react to form NH_4OH which will consist of ions NH_4^+ and OH^-. But the tendency to form a compound such as this is much less than in the case we have just considered, for the charge on the kernel of the oxygen atom is less than that of the fluorine atom so it has less tendency to become negative. As a result NH_3 is much less active towards H_2O than towards HF. Examples of this kind can be extended almost indefinitely and can even be used to obtain quantitative relationships between the heats of formation of various substances.

Since the sheaths of atoms of atomic number less than about 25 never contain more than 8 electrons, the covalence of these atoms can not exceed 4. With heavier atoms, however, we might expect in some cases larger covalences than 4. Large covalences are improbable in most cases for they imply equally large negative valences which means that the number of electrons in the sheath must be very much larger than the charge of the kernel. There are a few compounds, however, which suggest that large covalences sometimes exist. For example the compounds $Fe(CO)_5$ and $Ni(CO)_4$ correspond to complete compounds in which the central atoms have the covalences 10 and 8 respectively. Since e for iron is 8 and for nickel is 10 and the complete sheaths for these atoms contain 18 electrons, the negative valences of iron and nickel are 10 and 8, that is the same as the covalences needed to account for the above compounds. Thus these compounds are in accord with both Postulates 1 and 3, and are to be regarded as of a type analogous to organic compounds in which the covalence of *every atom* is equal to its negative valence. It should be noted that both of these compounds are liquids of low boiling point (102° and 43°) and their molecular weights have been determined. Their properties are about those to be expected if they have the structure assumed above. Other compounds of iron with carbon monoxide are known, but they have only been obtained in

the crystalline state and their molecular weights are unknown.

Molybdenum carbonyl, $Mo(CO)_6$,[5] is a very easily *volatile* crystalline compound. It is interesting to note that the *negative valence* of molybdenum ($s - e = 18 - 6$) is twelve, so that with a covalence of 12 for the molybdenum atom in this compound we again obtain a structure consistent with the valence theory discussed above.

2. Incomplete Compounds.—These are compounds in which some of the electrons are not arranged in complete layers or sheaths, so that the tendency of Postulate 1 is not completely satisfied. This can only occur as a result of a conflict between Postulate 1 and Coulomb's law or Postulate 3. We have seen that the tendency of Postulate 3 causes the residual charge (v) on each atom to be a minimum. The tendency of Postulate 1, however, is sufficiently strong to force the atoms to take up charges of 3, 4, or even under some conditions, 5 or 6 units, if this should be necessary in order to bring all the electrons into complete layers. Since there must be a limit to the strength of the tendency of Postulate 1 it is not surprising that residual atomic charges greater than 4 or 6 are very rare. Now the atoms of the elements near the middles of the long periods (of 18 and 32 elements), do not become complete even if they do acquire residual charges as great as 5 or 6 units, and it is therefore natural that the tendency of Postulate 3, which must become stronger as the charge increases, should prevent the formation of complete compounds of these elements. There are two types of incomplete compounds to consider.

a. Metallic Substances. Electronegative Atoms Absent.—By Coulomb's law, atoms having only small charges on their kernels, should not be able to take up enough electrons to complete sheaths of 8 or more electrons. Thus if we bring together a number of electropositive atoms there is no way in which the electrons in the incomplete sheaths can rearrange themselves to form complete sheaths. The "free" electrons which are thus compelled to remain in incomplete sheaths are responsible for the metallic properties shown by all electropositive elements in the solid or liquid state. It is clear, however, notwithstanding the fact that hydrogen may sometimes function as an electropositive element, that liquid or solid hydrogen should have none of these metallic properties according to this theory, for the sheath to be formed in this case contains only two electrons. The forces acting between the free electrons and the kernels of the atoms in metallic substances, are of the same order of magnitude as in salts, so that metals have about the same range of vapor pressures, hardness, compressibilities, etc., that are shown by salts.

In general, all atoms must be electropositive unless they can take up enough electrons to complete their sheaths and thus act as electronegative atoms. The tendency of Postulate 3 ordinarily prevents the occurrence of negative valences greater than about 4. In the two short periods eight electrons are needed to form a complete sheath so that the elements with kernel charges greater than about 3 can act as electronegative atoms and therefore do not normally show metallic properties. In the 2 long periods 18 electrons form the complete sheath so that about the first 14 of the elements in each of these periods can usually act only as electropositive elements and they thus have metallic properties, when in the elementary form. For similar reasons all the known elements of the rare earth period (the last two being unknown) have metallic properties.

b. Compounds Containing Electropositive and Electronegative Atoms.—As a result of Coulomb's law or Postulate 3, the positive valence of an element is usually limited to a value of 2 or 3 unless particularly strong forces are exerted to draw away electrons, and thus raise the positive valence a few units higher. Thus in the middle of the long periods the charges of the kernels are so great that all the electrons in the sheaths of the electropositive atoms can not be given up even when other atoms are present that can take up electrons. It thus happens that the long pe-

[5] Mond, Hirtz, Cowap, *J. Chem. Soc.*, 97, 798 (1910).

riods contain series of elements which all have 3 or 2 and 3 as their principal valences. The atoms of these elements are therefore incomplete. The electronegative atoms in such compounds, however, are always complete.

It is of interest to note that as long as atoms are incomplete there seems to be no tendency for them to have an even rather than an odd number of electrons. For example, the following ions all have odd numbers of electrons: Cr^{+++}, Mn^{++}, Fe^{+++}, Co^{++}, and Cu^{++}. This seems to indicate that the remarkable tendency, pointed out by Lewis, for most compounds to contain even numbers of electrons is due merely to the relative abundance of complete compounds as compared to incomplete ones. In other words, the even number of electrons in most compounds results from the tendency of Postulate 1 rather than from any more general tendency for electrons to form pairs.

Many of the compounds of this class, such as ZnO (zincite), Fe_3O_4, PbS, CuO, etc., show electric conductivity even as solids. This is undoubtedly caused by the relatively large number of electrons in incomplete sheaths. Of course we should not expect all compounds which contain such electrons to show conductivity, for the presence of the electronegative atoms might easily prevent the mobility of these electrons. We need to know much more than we now do about the arrangement of the atoms and their electrons in space before we can predict conductivity in particular cases of this kind.

3. EXCEPTIONAL CASES.—There are some substances or compounds whose structure is not adequately accounted for by the foregoing analysis. A few examples are: N_2, CO, CN^-, NO. The writer believes these have the single octet structure which he described in his earlier publications. It is probable that acetylene, C_2H_2, and the carbide ion C_2^{--} (in CaC_2, etc.) have the same kind of structure. Pease has suggested that they may all have a triple bond structure.[6] This question merits careful study.

Another set of compounds that must have a special structure are various compounds of boron such as B_2H_6.

Most compounds containing molecules of H_2O, NH_3, etc., are readily accounted for by Postulate 3 but many of these should be considered by methods somewhat different from those developed here.

In double molecules such as H_4O_2 (in ice), H_2F_2, and in compounds such as KHF_2, etc., it seems that the hydrogen nuclei instead of forming duplets with electrons in the same atom, form duplets in which the two electrons are in different atoms. The hydrogen nucleus itself thus acts as a bond in such a case. Latimer and Rodebush[7] have made a somewhat similar suggestion in regard to hydrogen nuclei acting as bonds. They consider, however, that the hydrogen nucleus acts on two pairs of electrons: one pair in each of the two atoms. It seems to the writer much more probable that the hydrogen nucleus is no more able to attract four electrons than is the nucleus of other atoms. Since the first layer of electrons in all atoms contains only 2 electrons it seems probable that the hydrogen in this case also holds only two electrons and that these form the definite stable group which we have termed the duplet.

The writer plans to consider the quantitative aspects of these valence theories in subsequent papers. It is aimed to put Postulates 1 and 3 into a form that will permit at least rough calculations of the relative stabilities of various substances as measured, for example, by their heats of formation.

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RESEARCH LABORATORY,
GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y.,
June 29, 1921

[6] *Jour. Amer. Chem. Soc.*, 43, 991 (1921).

[7] *Jour. Amer. Chem. Soc.*, 42, 1431 (1920).

PROFESSOR H. BRUCHMANN

THE men who gave such distinction to botany in Germany during the latter half of the nineteenth century, have mostly gone, the years since 1914 taking heavy toll of those who were left when war broke out. Among the last of the veterans was Professor Bruchmann

whose death occurred on Christmas day, 1920.

A copy of the *Gothaisches Tageblatt* recently received by the writer contains an interesting sketch of his life, and shows the high esteem in which he was held by his fellow-townsmen in Gotha, where the greater part of his life was spent.

While Bruchmann is, perhaps, not so well known in America as some of his contemporaries, his work was of a very high order, and eminently worthy of recognition, and is quite indispensable to students of the Pteridophytes, which were his chosen field of study.

Helmut Bruchmann was born in Pollow, a small town of Pomerania, November 13, 1847. After his preliminary schooling he studied at Jena, where he became associated with Strasburger, who quickly recognized his abilities, and would gladly have kept him, as assistant in Jena, but financial reasons made it necessary to seek more remunerative employment.

In 1877 he accepted a position as teacher in the high school of Gotha, where he spent the remainder of his life. Later he received the title of professor.

Bruchmann's name will always be associated with his truly remarkable studies on the life history of the European species of *Lycopodium.* These familiar plants had hitherto baffled all efforts to trace their life history, and Bruchmann spent nearly twenty years at work before he published his monograph in 1898. This is a masterpiece of careful work, and its great value was quickly recognized. The patience required to complete this work will be appreciated when it is realized that in some species six to seven years elapsed before the first germination stages were evident and twelve to fifteen years before the prothallia were mature.

This monograph was followed by further investigations in *Lycopodium,* and also very important papers on the gametophyte and embryo of *Botrychium lunaria* and *Ophioglossum vulgatum,* the first connected account of the development of these ferns. These, with several notable papers on *Selaginella* comprise his most important contributions.

Douglas H. Campbell

Stanford University, California

SCIENTIFIC EVENTS

FIELD WORK OF THE SMITHSONIAN INSTITUTION

The Smithsonian Institution has issued its annual exploration report describing its scientific field work throughout the world in 1920. Twenty-three separate expeditions were in the field carrying on researches in geology, paleontology, zoology, botany, astro-physics, anthropology, archeology, and ethnology, and the regions visited included the Canadian Rockies, fourteen states of the United States, Haiti, Jamaica, four countries of South America, Africa from the Cape to Cairo, China, Japan, Korea, Manchuria, Mongolia, Australia, and the Hawaiian Islands.

In an outline of the year's work, the Institution says that

> Secretary Walcott continued his geological work in the Cambrian rocks of the Canadian Rockies in the region northeast of Banff, Alberta. The work was hindered considerably in July and August by forest fires, and by continuous stormy weather in September, but the particular questions involved in the season's research were settled satisfactorily and some beautiful photographs of this wild and rugged region obtained. Other geological field work was successfully carried on in various states of the United States by members of the staff.
>
> In astrophysical research the institution was unusually active. Through the generosity of Mr. John A. Roebling of New Jersey, the Smithsonian solar observing station located on the plain near Calama, Chile, was moved to a nearby mountain peak, where the observations will be unaffected by the dust and smoke, and a new station was established on the Harqua Hala Mountain, Arizona, probably the most cloudless region in the United States. From daily observations of the radiation of the sun at these two widely separated stations, it is hoped to establish definitely the value of the "solar constant" observations in forecasting weather. Dr. C. G. Abbot, director of the work, also describes the successful operation on Mt. Wilson, California, of a solar cooker devised by him. With this apparatus it was possible, using only the sun's heat, to cook bread, meat, vegetables, and preserves.
>
> Mr. H. C. Raven represented the Smithsonian on an extensive collecting expedition through Africa from south to north. Although many difficulties were encountered, among others a railway wreck in which two members of the expedition

were killed, Mr. Raven shipped to the Institution much interesting zoological material, which was greatly needed for purposes of comparison in working up the famous Roosevelt and Rainey collections already in the National Museum. Many interesting photographs of the animals, the natives, and the country itself are shown in this account and in that of Dr. Shantz, who accompanied the expedition as a botanical collector. In Australia, a Smithsonian naturalist collected, through the generosity of Dr. W. L. Abbott, specimens of the fast disappearing remarkable fauna of the continent, while Dr. Abbott himself secured a great number of plants, birds, and other natural history material for the National Museum, in various regions of Haiti. A number of other zoological and botanical expeditions are briefly described and illustrated.

THE MEDICAL SCHOOL OF THE UNIVERSITY OF VIRGINIA

AT a session held in Cabell Hall on June 3, the General Alumni Association of the university unanimously adopted resolutions opposing the removal of the medical school to Richmond. An address was made by Dr. Alderman appealing for the preservation of the integrity of the university.

The resolutions as adopted are as follows:

WHEREAS, the commission on medical education in Virginia has, by a vote of 5 to 4, recommended the consolidation of the Medical College of Virginia with the medical department of the University of Virginia, and that the consolidated institution be operated as the medical department of the University of Virginia, and located in Richmond; and,

WHEREAS, the overwhelming weight of the testimony of disinterested experts of national reputation opposes, as utterly contrary to the best scientific thought of the day, the separation of the medical department of the University of Virginia from the other departments of the university and favors, with singular unanimity, its retention at Charlottesville; . . .

Resolved, That the General Alumni Association of the University of Virginia hereby expresses its unqualified opposition to the proposed removal to Richmond of the medical department of the university as a step opposed to the interests of the state of Virginia, as injurious to the cause of medical education, as destructive of the integrity of the University of Virginia, and as violative of those principles of higher education which, established by Thomas Jefferson, have received the sanction of time and of experience.

Resolved, further, The president of this association be and he is hereby instructed and empowered to appoint such committee, make such expenditures and do such other acts and things as in his judgment will best effectuate the purpose of these resolutions and preserve and protect the educational fabric of the state of Virginia.

THE SCIENCE CLUB OF THE UNIVERSITY OF TEXAS

During the academic year 1920–21, the Science Club of the University of Texas, composed of members of the university science faculties, held eight meetings. The following papers were presented:

Oct. 11, 1920. "Some modern conceptions of the atom," by W. T. Mather, Professor of Physics.

Nov. 1, 1920. "Habits and instincts of spiders," by T. S. Painter, Adjunct Professor of Zoology.

Dec. 6, 1920. "Relative birth-rates of white and colored races," by J. E. Pearce, Associate Professor of Anthropology.

Jan. 3, 1921. "The occurrence of latex (milk) in plants," by F. McAllister, Associate Professor of Botany.

Feb. 7, 1921. "Luminescence," by H. B. Weiser, of Rice Institute, Exchange Lecturer from the Houston Philosophical Society.

March 7, 1921. "Species of the genus *Schwazerina* and their stratigraphic significance," by J. W. Beede, Geologist in the Economic Geology Division of the Bureau of Economic Geology and Technology.

April 4, 1921. "Past, present, and future of plant pathology," by J. J. Taubenhaus, Chief of Division of Plant Pathology, Texas Experiment Station, Exchange Lecturer from the Science Seminar of the A. and M. College of Texas.

May 2, 1921. "Possible improvements in petroleum refining," by E. P. Schock, Professor of Chemistry.

The exchange lectureships with Rice Institute and Texas A. and M. college have been made annual events.

The officers for the year 1920–21 were

Dr. H. P. Bigbee—president.

Dr. H. J. Ettlinger—secretary-treasurer.

The officers elected for the year 1921–22 are

Dr. H. J. Ettlinger—president.

Dr. T. S. Painter—secretary-treasurer.

H. J. Ettlinger,
Secretary

THE ROCHESTER MEETING OF THE OPTICAL SOCIETY OF AMERICA

The Optical Society of America will meet in Rochester, N. Y., on Monday, Tuesday and Wednesday, October 24, 25, and 26, at the Hotel Rochester. In order to provide the maximum opportunity for social meetings of members and guests, arrangements will be made for society lunches and dinners.

The regular sessions for the reading of papers will be open to all interested persons.

Members and others desiring to communicate results in optical research are invited to submit titles of papers for the program to the secretary any time before September 25. No arbitrary time limit is set for the presentation of a paper, but each author is requested to estimate *carefully* the time which will be sufficient to present his paper briefly and intelligibly, and to submit this estimate with the title.

Each title must be accompanied by an abstract (100 to 200 words). Authors are urged to make every effort to present the essence of their papers as cogently as possible in these abstracts. It is expected that they will be printed in the program and in the minutes of the meeting. No titles will be printed to be presented "by title."

Persons having papers ready for publication which can not be presented at the meeting are invited to submit them to Paul D. Foote, editor, *Journal Optical Society of America*, Bureau of Standards, Washington, D. C.

Because of the optical industries in Rochester it is expected that this will be a particularly interesting meeting. The local committee is arranging for a visit to the Bausch and Lomb Optical Company and the Eastman Kodak Company.

The National Research Council Committee on Physiological Optics has asked the society to form a section on vision. It is hoped to do this at the coming meeting; and, if a sufficient number of papers on this subject are submitted, one whole session will be devoted to vision and physiological optics.

For further information in regard to the society consult Science for April 1, 1921.

Irwin G. Priest,
Secretary

AMERICAN ENGINEERS IN EUROPE

With the presentation of the John Fritz Medal to Eugène Schneider, head of the famous Creusot Works, in Paris on July 8, by a mission of American engineers, came cable advices from London to the national headquarters of the American Society of Mechanical Engineers announcing that more foreign honors had been conferred upon Americans distinguished in the engineering profession.

Ambrose Swasey, of Cleveland, sponsor of the Engineering Foundation and past president of the American Society of Mechanical Engineers, has been elected to honorary membership in the British Institution of Mechanical Engineers, in the British Institution of Mining and Metallurgy and in the British Institution of Mining Engineers. Charles F. Rand, of New York, has been elected an honorary member of the Institution of Mining and Metallurgy, and of the Institution of Mining Engineers. Mr. Rand, who is chairman of the executive board of the Engineering Foundation, has also been made an honorary member of the British Iron and Steel Institute. Other elections announced by cable were those of Colonel Arthur S. Dwight, of New York, and William Kelly, of Vulcan, Mich., to honorary membership in the Institution of Mining Engineers.

The ceremonies in Paris, participated in by a special deputation of thirteen American engineers under the general chairmanship of Mr. Swasey, followed similar ceremonies in London on June 29, when the John Fritz Medal for distinction in applied science was presented to Sir Robert Hadfield, known for his work in the development of manganese steel. The Hadfield award was for 1921 and

the Schneider award for 1922. M. Schneider received the gold medal in person for his achievements during the war "in the industrial and scientific defense of civilization." The John Fritz Medal Board of Award, in conferring the honor, lauded M. Schneider's "achievements in the metallurgy of iron and steel, in the development of ordnance, especially the 75 mm. gun, and in notable patriotic contribution to the winning of the war."

SCIENTIFIC NOTES AND NEWS

FRANCIS BACON CROCKER, electrical engineer, until 1914 professor in Columbia University, died on July 9, at the age of sixty years.

GABRIEL LIPPMAN, professor of physics in the University of Paris, the recipient of a Nobel prize in 1908, died on the steamship *France* on his return with the French commission sent to Canada to express France's appreciation of Canada's services in the war.

THE council of the Society of Chemical Industry has nominated Professor R. F. Ruttan, of Montreal, as president for the session 1921–22. The annual meeting of the society will be held in Montreal in August.

THE University of Oxford conferred on June 22 the honorary degree of doctor of science on Professor C. S. Sherrington, president of the Royal Society.

PROFESSOR HENRI BERGSON has retired from the chair of philosophy at the Collège de France.

DURING a colonial health conference, the British government gave a dinner on June 13, at the Carleton Hotel, London, in honor of Drs. George E. Vincent, Wickliffe Rose, and Vincent G. Heiser, representatives of the Rockefeller Foundation. Mr. Winston Churchill, secretary for the colonies, presided.

RICHARD T. FISHER, assistant professor of lumbering and forestry and director of the Harvard Forest, has been elected chairman of the New England Section of the Society of American Foresters. At the recent National Conference on Forest Education, he was appointed chairman of the committee on research in forest schools; that committee has been continued as a standing sub-committee of the Society of American Foresters.

THE American Society of Mechanical Engineers announces the appointment as managing editor of C. E. Davies, associate editor, to succeed the late L. G. French, who was both editor and manager of the society's publication. The June issue of *Mechanical Engineering* contains eulogies of the work of Mr. French, including resolutions of appreciation adopted by the council of the society and by the boiler committee.

DEAN W. R. APPLEBY, of the School of Mines, and Professor W. H. Emmons, director of the State Geological Survey and head of the department of geology and mineralogy at the University of Minnesota, left about the first of June for Northern China, where, in conjunction with other scientific men, they will make a general survey of the mineral resources of the region.

DR. DOUGLAS HOUGHTON CAMPBELL, of Stanford University, sailed for Australia on July 5. Dr. Campbell expects to spend six months in Australia, New Zealand and Tahiti, to extend his studies on the Pacific floras, especially in relation to the origin of the Hawaiian flora.

PROFESSOR KARL M. WIEGAND, of Cornell University, and Mrs. Wiegand, with a party of students, are making a botanical trip by automobile to the Pacific coast.

DONALD B. MACMILLAN sailed from Wiscasset, Me., on July 16 for Baffin Land on the 115-ton schooner *Bowdoin*. The program of the scientists of the expedition calls for field work in zoology, botany, geology, meteorology and terrestrial magnetism. Special observations will be taken of the magnetic pole, which was located first by James Ross in 1830 on the further side of the Boothia Peninsula, not far from Mr. MacMillan's proposed winter camp.

A COMPANY has been formed at Vancouver, B. C., with Mr. Vilhjalmur Stefansson as

president, to conduct further explorations in the Arctic regions to the extreme north of Canada. It is said that he expects to investigate the possibilities of marketing reindeer and of developing the fur trade in the Arctic circle, as well as to continue his scientific explorations.

The Rede lecture at the University of Cambridge was delivered on June 9 by Sir Napier Shaw on "The air and its ways."

The lectureship established in London to commemorate the work of Moncure Conway was held this year by Dr. A. C. Haddon, who selected as his subject "The practical value of ethnology."

The college of agriculture of the University of Georgia announces the formation of a forestry camp in Fannin County, Georgia. This camp in the heart of the Cherokee National Forest Reservation is known as the Henry McHatton Forestry Camp, being named after Dr. Henry McHatton, a physician and naturalist of Macon, Georgia. The camp site was given to the university by Dr. McHatton's son as a memorial to his father.

We learn from *Nature* that the Ottawa Field-Naturalists' Club has decided to open a subscription list for a permanent memorial to the late Professor John Macoun, naturalist of the Geological Survey of Canada, who died at Sidney, British Columbia, on July 18, 1920. Professor Macoun specialized in botany, and was the founder of the Canadian National Herbarium. Other sciences, however, especially zoology, were enriched by him. The memorial will take the form of a portrait to be hung in the Victoria Memorial Museum, which will be executed by Mr. Franklin Brownell, of Ottawa. Subscriptions, which should be forwarded to Mr. Arthur Gibson, Dominion Entomologist, Ottawa, are invited.

The president and secretary of the American Chemical Society have authorized another meeting of the Cellulose Section in connection with the fall meeting of the parent society in New York, September 6–10, 1921. Professor Harold Hibbert has been reappointed chairman and Gustavus J. Esselen, Jr., secretary. This will be the fourth consecutive session devoted to cellulose and its derivatives, a symposium on the subject having been held in both St. Louis and Chicago, and the first meeting of the Cellulose Section, as such, at Rochester last April. At this last meeting great interest was shown and there is no doubt that the Cellulose Section has made a place for itself in the activities of the American Chemical Society. It is the plan this year to issue the preliminary program much earlier than on previous occasions, and accordingly those who plan to present papers before the Cellulose Section are urged to send the titles at once to the secretary of the section, G. J. Esselen, Jr., 248 Boylston St., Boston, 17, Mass.

UNIVERSITY AND EDUCATIONAL NEWS

Louisiana State University will receive $7,500,000 for new buildings and equipment as a result of the action of the Constitutional Convention which has just adjourned, this sum having been set apart for this purpose from funds accruing from the newly established severance tax on oil and other natural resources. Plans are now being made for the erection of the new buildings on a 2,000-acre tract near Baton Rouge, Olmstead Brothers, of Brookline, Mass., having been secured as landscape architects. The new constitution, which has just gone into effect, also provides for a half-mill tax, which it is estimated will yield an annual income of approximately $1,000,000 for the maintenance of the university.

Dr. Thomas W. Salmon has been appointed professor of psychiatry at the Columbia University College of Physicians and Surgeons, and has resigned from the staff of the Rockefeller Foundation. Dr. Salmon will continue to serve as medical director of the National Committee for Mental Hygiene.

Dr. Harold E. Robertson, formerly director of pathology and bacteriology in the medical school of the University of Minnesota, has been transferred to the staff of the Mayo Foundation of the university as professor of

pathology. Dr. Robertson has also become a member of the staff of the Mayo Clinic as head of the section on pathologic anatomy.

DR. CHARLES A. SHULL, now of the University of Kentucky, has been appointed in charge of plant physiology at the University of Chicago, to succeed Dr. Wm. Crocker, who has resigned to become the director of the Thompson Institute for Plant Research at Yonkers, N. Y.

DR. R. G. HOSKINS, associate in the Johns Hopkins University, has accepted the position of professor and head of the department of physiology in the Ohio State University.

AT George Washington University Dr. John T. Metcalf, assistant professor of psychology, has resigned to accept a call from the University of Vermont as associate professor of psychology, and Mr. F. A. Moss, development specialist at Camp Dix, N. J., has been appointed to fill the vacancy.

DR. WILLIAM H. COLE has been appointed to the chair of biology at Lake Forest College, to succeed Dr. W. C. Allee.

DR. H. M. DADOURIAN, associate professor of physics at Trinity College, is in charge of the physics department in the absence of Professor H. A. Perkins, who is in Europe on a year's leave of absence.

AT the University of Liverpool Dr. McLean Thompson, of the University of Glasgow, has been appointed to the Holbrook Gaskell chair of botany in succession to Professor R. J. Harvey-Gibson, who has resigned.

DISCUSSION AND CORRESPONDENCE

THE GEOGRAPHIC DISTRIBUTION OF HYBRIDS

TO THE EDITOR OF SCIENCE: In your issue of June 17, 1921, Professor Jeffrey, protesting against the assumption "by systematic botanists in this country that natural hybrids between species can only exist within the common range of the parent species," calls to his support cases cited by Kerner von Marilaun in the *Pflanzenleben* and elsewhere, saying:

> Perhaps the most interesting example in this connection is the hybrid *Nuphar intermedium* which is a cross between *Nuphar luteum* and *Nuphar pumilium*. . . . It is capable of extending its latitude northward of the range of both the parent species.

Nuphar intermedium is thus parallel with the blackberries which I have discussed elsewhere and, since Kerner is called into the discussion, it is well to quote his conclusion regarding *Nuphar intermedium*.[1]

> At the northern extremity of this large area of distribution *Nuphar intermedium* is more abundant than the species from which it is derived; indeed in many places it occurs in their absence, and in fact passes beyond the northern limits of their area of distribution. . . . *Nuphar intermedium* subsists independently there, multiplies without change of form, and has in fact established itself as a species.

On the same page Kerner discusses two other cases, *Salvia sylvestris* and *Rhododendron intermedium*. Where it occurs with *Salvia nemorosa* and *S. pratensis*, *S. sylvestris* is interpreted as a hybrid, but it has extended its range beyond either of the two former and Kerner tells us that

> Its fruits ripen in as large numbers as in the case of *S. nemorosa* or *S. pratensis*, and have been found by experiment to be fertile in a proportion of more than 60 per cent. *Salvia sylvestris* has therefore scattered itself . . . and manifests all the characteristics essential to our conception of a species.

Again, *Rhododendron intermedium*, when growing with *R. ferrugineum* and *R. hirsutum*, is considered a hybrid between them; but Kerner tells us that, in several areas *R. intermedium* dominates the vegetation of the mountain sides,

> develops fruits with fertile seeds, and transmits its characteristics unaltered to its descendants. . . . This form accords in every particular with the requirements demanded of a species, and is quite as much a systematic entity as either *R. ferrugineum* or *R. hirsutum*.

The cases of *Rubus*, which stimulated Professor Jeffrey's note, are exactly parallel with *Nuphar intermedium* (specially cited by Jef-

[1] I quote from Oliver's translation of "Pflanzenleben," Vol. 2, pp. 588–590.

frey) and others discussed by Kerner, and I greatly appreciate having my attention called anew to such an authoritative support of my thesis as is given by Kerner.

M. L. Fernald
Gray Herbarium,
Harvard University

ALBINISM IN THE BLACK BEAR

Several notes on albinism in wild animals and birds have been published in Science. An interesting reference to albinism in the bear is given in a rather rare work upon the adventures of John Tanner during his thirty years' residence among the Indians.[1] While living on the Assinneboin River he had the following experience:

> Shortly after this, I killed an old she bear, which was perfectly white. She had four cubs, one white, with red eyes, and red nails, like herself; one red [brown?], and two black. In size, and other respects she was the same as the common black bear, but she had nothing black about her except the skin of the lips. The fur of this kind is very fine, but not so highly valued by the traders as the red. The old one was very tame, and I killed her without difficulty; two of the young I shot in the hole, and two escaped into a tree. I had but just shot them, when there came along three men, attracted, probably, by the sound of my gun. As these men were very hungry, I took them home with me, fed them, and gave each of them a piece of meat to carry home.

An interesting feature of this case is the fact that one of the young also was albinistic. Had albinism been a recessive trait, the albinistic mother could hardly have produced albinistic young unless mated to an albinistic individual or to another individual carrying albinism recessive. This latter supposition indicates prior cross and persistence of albinism in the same locality.

It is interesting to note the high fertility of this albinistic individual.

Paul C. Standley
U. S. National Museum

[1] A narrative of the captivity and adventures of John Tanner (U. S. interpreter at the Saut de Ste. Marie), during thirty years residence among the Indians in the interior of North America, prepared for the press by Edwin James, New York, 1830, page 131.

BECHHOLD'S "CAPILLARY PHENOMENON" IN AGRICULTURE

H. Bechhold recently observed[1] the interesting capillary phenomenon that when a porous mass (such as a lump of earth or a block of plaster of Paris) is soaked in the solution of a salt and then dried, the salt collects almost quantitatively at or near the exterior surfaces. W. Kraus[2] has shown that this transfer of the salt is dependent upon evaporation at the exposed surfaces.

The above observations seem to me to give the scientific reason for the well-recognized value of cultivation or tilth in agriculture.

When the surface of the soil is stirred or broken up by a cultivator, hoe, or rake, besides killing weeds and "hilling up" the plants, a greater total surface is exposed to evaporation, and evaporation is therefore facilitated. The sub-surface water in rising, brings with it towards the roots, soluble substances which serve as plant food, though of course selective adsorption and differential diffusion effect some segregation. This capillary rise of water also accounts for the curious fact well known to farmers, that in dry weather cultivation will to a considerable extent furnish moisture to the growing crop.

Jerome Alexander
Ridgefield, Conn.,
June 21, 1921

QUOTATIONS

THE ROYAL INSTITUTION

In these days of grandiose state expenditure and trifling result, the history of the Royal Institution seems almost miraculous. It has occupied its present quarters in Albemarle-street since 1799, when it was founded by a few fellows of the Royal Society, of whom the American, Count Rumford, also founder of the Smithsonian Institution at Washington, provided the initial funds. Its purpose was severely practical—to "diffuse knowledge of useful mechanical improvements," to "teach the application of science to the useful purposes of life." But its wise governors soon found that teaching tends to be barren if it is divorced from research, and its laboratories, at

[1] *Kolloid Zeitschrift*, 27, 229 (1920).

[2] *Kolloid Zeitschrift*, 28, 161 (1921).

first intended to furnish the materials for demonstration, become centers of active investigation. What a chain of famous names and brilliant discoveries is associated with this private enterprise! In July, 1801, Thomas Young became the first resident professor; he was the father of all our knowledge of color vision and of the properties of the lens of the human eye, the discoverer of "interference" and the first to define "energy." Humphry Davy joined the institution in 1801, at a salary of £100 a year, a room, coal and candles, in return for which he gave his patrons lectures which drew all London, and gave the world the anæsthetic nitrous oxide, the safety-lamp, the process of electrolysis by which he discovered potassium and sodium, and many of the foundation stones of modern scientific knowledge. To Davy succeeded Faraday, a name inseparable from the history of science, and to him Sir James Dewar, the present resident professor, joint inventor of cordite, inventor of the thermos flask, the first man to liquefy hydrogen, the profoundest student of low temperatures. So far as can be traced, the sole support given by the state to this brilliant and beneficent accomplishment was a Civil List pension of £300 enjoyed by Faraday for a few years. Still more wonderful is the small total cost, amounting for the whole of the nineteenth century to only £100,620 for the professors, attendants, and laboratories with their apparatus and materials. Gifts and donations have been few and small in amount; the revenue has been derived almost wholly from fees paid by the audiences who wished to see and hear the professors. There is no institution of which London should be prouder, none for which the world should be more grateful. Fortunately it flourishes, and offers no pretext for absorption by any state department.—*The London Times.*

SCIENTIFIC BOOKS

Lake Maxinkuckee, a Physical and Biological Survey. By BARTON WARREN EVERMANN, Director of the Museum of the California Academy of Sciences, and Howard Walton Clark, Scientific Assistant, U. S. Bureau of Fisheries Biological Station, Fairport, Iowa. Vol. 1, 660 pages; 36 colored plates; 8 half tone plates; 24 text figures. Vol. 2, 512 pages. Publication 7 of the Department of Conservation, State of Indiana.

The work on Lake Maxinkuckee by Dr. Evermann and Mr. Clark is the most comprehensive and most symmetrical treatment of the organisms and their physical environment of one of the numerous small inland lakes of America, yet published. The material of the volumes is almost entirely that obtained from the investigations in the region, there being scant reference to similar work done elsewhere. It is contributory largely to aquatic biology and ecology, but it appeals to a wide range of interests among naturalists. There is much for the specialist in ichthyology, ornithology, botany, and other special fields of natural science. Persons attracted by the recreational offerings of such a body of water as Lake Maxinkuckee, such as anglers, sportsmen, and campers will find much of interest in these books. Science teachers can use the work advantageously for developing in school pupils a wider and deeper interest in nature and outdoor life. The clear and readable style is favorable for teaching purposes as well as for a general use of the publication.

The work on Lake Maxinkuckee is likely to promote proper measures for conserving wild life since it contains information pertaining to the direct and indirect relations of the animals and plants of the region to man. This value was undoubtedly recognized by The Department of Conservation of the State of Indiana and determined its assuming the responsibility of the publication and distribution of the work.

The field investigations were carried on from 1899 to 1914 by the United States Bureau of Fisheries. Dr. Evermann, who was in charge, and Mr. Clark did most of the field work, but with them were associated at different times and for varying intervals eleven other investigators, who were: Dr. J. T. Scovell, Thomas Large, Chancey Juday,

T. Bronté Evermann, Harry Warren, S. S. Chadwick, Leonard Young, Wm. F. Hill, Millard Knowlton, Robert Gillum, and Dr. C. B. Wilson. The work was carried on mostly in the summer and fall, but something was done each month of the year.

The Bureau of Fisheries undertook the investigations at Lake Maxinkuckee through realizing the importance to fish culture of an exact knowlege of the physical and biological conditions in the different types of lakes and streams of the country including the small inland lakes of glacial origin like Lake Maxinkuckee. With reference to the importance of these investigations the authors say:

> With scarcely an exception these lakes teem with food and game fishes of the finest quality, besides many other species of greater or less importance. Many of these lakes are inhabited also by a large number of species of turtles, batrachians, mollusks and crustaceans, some of which are already used for food or otherwise utilized by man. They are the home also of many other species of aquatic animals and many species of aquatic plants which are known to serve an important purpose in the economy of the lakes in their relation to food fishes, and of still many other species whose status we do not yet know. The value of exact knowledge concerning this type of lake and the inhabitants thereof is appreciated by all biologists and fish culturists and can scarcely be overestimated.

Lake Maxinkuckee was chosen for special and detailed study principally for the following reasons: it was of suitable size, not being too large for any of its parts to be reached readily from a central station; the tributary waters were not of such large size as to "complicate the problem"; it was a fairly "homogeneous environmental unit"; there are fishing and angling interests there; it appeared to be "typical of the class of small glacial lakes"; it was easily accessible; and field expenses there were especially small.

The purposes of this work were chiefly three: (1) "To gain a fairly good understanding of the physical and biological conditions obtaining in a typical glacial lake. Accurate knowledge of *one* lake of a type enables a study of other lakes of that type to be made more readily and easily." (2) "To study carefully the physical and biological conditions under which the more important of the species thrive." (3) "To study carefully and fully the habits of as many species of animals and plants of the lake as time permitted."

The treatment is under two main topics: (1) Physical Features and (2) Biology. Under the first are discussed in some two hundred pages the location, size, form, depth, bottom topography, soils, lake tributaries, character of the surrounding country, and weather conditions. Under the topic, Biology, are taken up, first, a consideration of the five classes of vertebrate animals represented in the region with a general introductory discussion of each followed by descriptions of the species found, and secondly (in Volume 2) similar discussions of the invertebrates and plants.

Fish naturally receive most attention and 213 pages are given to this group. The account is a useful one, not only for zoologists but for others likely to read or consult the work, since the majority of the 64 species described are very generally distributed in such lakes, and at least two dozen of them are well known to most anglers. The discussions deal with the species found, and for each are given notes on its status in the region and structural details of taxonomic interest, and for most of them facts on behavior, food, enemies, angling, and economic importance are included.

The data on the food of the fish are important. Although these are chiefly qualitative in character, they are of considerable ecological value. Determinations of the percentages of the different food materials in the digestive tracts may still be made, since it is probable that these were preserved. However, no reference can be found concerning the disposition of the food collections or other collections made during the progress of the survey of the Maxinkuckee region. There is a detailed account with list of species of each collection made at each of the many numbered stations; and it would have been important to have stated where these collec-

tions are available for future workers in the region or by specialists on the different groups represented in them.

Preceding the annotated list there is a lengthy general discussion describing collecting methods, conditions for fish life at the lake, migrations and seasonal movements, fishing, fish protection, and fish planting. A three-page table with the results of dredging is of considerable biological interest, and there are two other tables, which are especially unique and interesting. One of the two shows the number of fish taken by a single angler during nine months and the other the number of boats seen on the lake correlated with weather conditions during two summer months. A part of this discussion of fishes is a fifteen-page contribution by Charles B. Wilson on "Food and Parasites of Fishes."

The treatment of the fish of the region is followed by that of mammals. Why the mammals are taken up here is apparently not explained. Thirty species are listed with many notes. The ones having the most direct relation to the life of the lake are muskrats, minks, otters, and raccoons. There is a long account of the muskrat, which is a very positive contribution to its natural history, and the data given on the numbers caught there by trappers will be useful in estimating the value of the small inland lakes as a source of muskrat fur.

The ninety pages of information on the birds include an annotated list of 175 species. At least fifty of these were found to be very directly and closely related ecologically to the fish and other organisms of the lake. The number of aquatic and shore birds is large and the total of their influence upon the life of the lake is considered to be great. Some food studies of water birds contribute to the meager knowledge of the relation of these birds to fish. The twelve pages on the coot are an important addition to the literature of this unique water bird.

The reptiles are treated in about forty pages and they seem to be of little importance in the biology of the lake except the turtles, which were important as scavengers. Detailed shell measurements and weights are recorded for 225 examples of four species of turtles.

The water dog (*Necturus maculosus*) was worthy of more consideration than any of the other 18 kinds of amphibians found, and it is concluded from food studies of the water dog that, of all the animals inhabiting the lake, it was the worst enemy of fish.

The material gathered concerning the invertebrates and plants of the Maxinkuckee region composes the second volume. The slight attention that could be given to a group so abundantly represented and so important causes a disappointment. The May-flies and dragon-flies were found to be of special importance to the fish of the lake. A list of 56 species of dragon-flies with important notes is given, and this was formed through the help of Mr. E. B. Williamson. Notes on life-histories, behavior, and ecology are given on many other forms. A notable contribution showing the value of chironomid larvæ as fish food comes from the finding of "almost a bucketful" of them in a 75-pound buffalo-fish (*Ictiobus cyprinella*).

The mollusks follow the insects but precede the other arthropods, an arrangement which is confusing. Mussels are fully discussed with much attention to the fourteen local forms, with many data on their food, enemies, diseases, and reproduction. The 116 other species of mollusks are listed without notes.

The account of the Crustacea of the lake is based largely on the plankton studies made there by Professor Juday and the investigations on the parasitic copepods by Dr. Wilson and of the crawfish by Professor William P. Hay. The inference "that plankton species of crustaceans constitute a large part, probably nearly all, of the first food of young fishes, and much of the food of some fishes throughout their entire lives" serves to corroborate a similar conclusion concerning the food of fish derived from the study of Illinois fish by Dr. S. A. Forbes.

The eleven species of leeches, which form a "fairly conspicuous part of the lake fauna" are discussed by Professor J. Percy Moore, of

the University of Pennsylvania. They infested fish, turtles, mussels, and snails. One species (*Dina fervida*) appears to be a scavenger only.

Little attention was given to the worms other than the leeches, and these with the sponges and protozoans are considered in only nine pages.

About three fifths of the second volume treats of the plants of Lake Maxinkuckee and vicinity, particularly with the aquatic forms. In addition to annotated lists of species there are important general discussions of such subjects as the uses of water plants to the other organisms of the lake and of the floral regions; the latter were found to be as follows: Beach; lake plains; low woodland; upland clay woodland; upland loamy woodland; gullies; woodland ponds; peat bogs; and shifting sand regions. No reference appears to be made to fungi, although it is well known that some forms like *Saprolegnia* attack fish.

Throughout the treatment of the plants of the region, there is much on their relation to fish and other life of the lake; and it is noted that:

> While the division line between the lake flora and the land flora is in most cases pretty sharply drawn, it is not easy to tell where the boundary line lies between plants having some influence upon the lake and those which have none, if there be such.

The grouping of species in the lists of water plants is puzzling and perplexing till one reads the easily overlooked explanation on page 135, where we are informed that floating plants are first disposed of and then those of the deeper water, proceeding from thence to the shallow water. In this arrangement species of a genus and sometimes subspecies of a species are separated. This is likely to be annoying to the taxonomist but not to students of ecology or plant distribution.

Only the first volume of the work has illustrations, and nearly all of these are of fish, there being a few of frogs, and some general views loaned by the Culver Military Academy. The latter are not numbered or referred to in the list of illustrations. The well-reproduced colored drawings, mostly from Forbes and Richardson's "Fishes of Illinois," give considerable attractiveness to the publication and also add to its scientific value since the fish are very accurately shown.

There is a large folded map in the back of the first volume. This has a scale of 400 feet to the inch and gives bottom contour lines for every difference of ten feet and for the depths 85 and 88 feet, 89 feet being the maximum depth found.

The books are well printed in a large, clear type on good, heavy paper, and there are very few typographical errors. All through the work is evidence of much painstaking. The binding is in good cloth. Withal they make an attractive addition to the naturalist's library as well as a useful publication for his reference and study.

T. L. Hankinson

The Roosevelt Wild Life
Forest Experiment Station,
Syracuse, N. Y.

SPECIAL ARTICLES

AN EXPLANATION OF LIESEGANG'S RINGS

Raphael Ed. Liesegang in 1898[1] published results showing that when silver nitrate solution is placed on a gelatine gel containing potassium bichromate, there develops on standing a series of concentric precipitations of silver chromate.[2] These zones are known as Liesegang's rings. Wilhelm Ostwald[3] published an explanation of the formation of these rings which was accepted until Liesegang,[1] Bechold,[4] and Hatschek[5] cited experiments which showed it untenable. Ostwald's explanation is briefly: Under certain conditions supersaturated solutions are formed, and when solid crystals or nuclei

[1] Liesegang, *Zeit f. Phys. Chemie*, 1907, 59, 444.

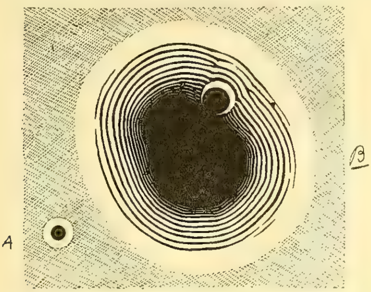
[2] For details see Ostwald-Fischer, "Theoretical and Applied Colloid Chemistry," Wiley and Sons, New York, 1918.

[3] Ostwald, "Lehrbuch der Allg. Chemie" (2 aufl.), II., 778.

[4] Bechold, *Zeit f. Phys. Chemie*, 1905, 52, 185.

[5] Hatschek, E., *Kolloid Zeitschrift*, 1911, 9, 97; 1912, 10, 124.

of precipitation are excluded, this supersaturated condition may persist for a considerable time without the spontaneous development of a solid phase. Such solutions he calls metastable. By the diffusion of the silver salt into the chromate gelatine, a solution is formed which in relation to the silver salt is supersaturated. A precipitate is formed only after the metastable limit has been exceeded. This precipitate occurs naturally in zones concentric with the drop. On the precipitate that is formed the silver supersaturated



The smaller figure (*A*) shows the sphere of influence of the silver nitrate. The larger figure (*B*) shows the effect of the smaller when included in the larger. Note that the smaller sphere has removed the chromate so that the rings in the larger are interrupted.

chromate in the region lasts until all the soluble silver is precipitated. Then the silver salt wanders out over the ring into the chromate gelation until a new supersaturated region is formed and the precipitation process is repeated.

The main objection to Ostwald's explanation is that a supersaturated condition has been shown unnecessary for ring formation; also that there are other factors involved in the ring formation.[4] Since no explanation has been accepted, I wish to present one which seems adequate.

The chromate in the gelatine is relatively fixed and diffuses very slowly; when $AgNO_3$ is added, there is an immediate formation of silver chromate not only under the silver solution but there is a sphere of influence which can be seen with the aid of a hand lens (see *A* figure). The silver attracts the chromate from this area and leaves it sharply demarcated. This demarcation could be due to the withdrawal of the chromate or it might be due to the influence of the potassium nitrate formed in the reaction. However, the amount of potassium nitrate that could be formed has no such influence on the gelatine chromate; and an experiment can be devised to show that there is no chromate, or very little of it, in this zone. The experiment is as follows: Place a minute droplet of silver nitrate on a gelatin plate until the zone of influence is distinct. Then at a short distance from it place a large drop of silver nitrate (*B*) sufficiently large so that when the Liesegang rings are formed they will include the smaller drop. After a time a condition develops as shown in figure where the larger circles are interrupted by the zone of influence of the smaller particle. This shows that there is not enough chromate to precipitate; it has all been attracted by the first silver nitrate. The explanation of Liesegang ring formation then is as follows:

Silver chromate is formed and a clear zone results in the gelatine by the attraction of the chromate to the silver. Beyond this zone of influence, the chromate is fixed and remains so unless an attraction force is exerted. The silver nitrate now wanders out through the ring into the clear zone until it approximates the chromate gelatine sufficiently close to exert an attraction force which again draws the chromate and forms another ring and clear zone. At the same time the chromate exerts a pull on the silver and the ring is formed where the forces are balanced. Again it may be presumed that to start the chromate moving, will require a greater force than to keep it moving after the start is made, consequently the second ring is separated from the first.

With each succeeding ring the concentration of the silver is less and this will also operate to remove the succeeding rings farther and farther apart. Ring formation by these or by other reagents depends on or is modified by

other conditions which are however of secondary importance. As a requisite, the precipitate formed must be permeable to the liquid solution used; in this case the silver nitrate. If for example, lead acetate be used instead of silver nitrate no ring formation occurs, because the lead chromate under these conditions is impervious to lead acetate. Not only is it impervious to lead acetate but if silver nitrate replace the solution of lead acetate after the precipitate of lead chromate is formed, silver nitrate will not penetrate the lead chromate wall, and no ring formation will occur. For the same reason if the silver nitrate and potassium bichromate solutions are reversed, no ring formation will occur.

Hugh McGuigan

College of Medicine,
University of Illinois

THE NORTH CAROLINA ACADEMY OF SCIENCE

The twentieth annual meeting of the North Carolina Academy of Science was held on April 29 and 30, 1921, at Wake Forest College, Wake Forest, N. C., with about 50 members present, and the following program was carried out.

Presidential address. The age of insects, Professor Z. P. Metcalf, State College.

PAPERS

The genus Raspaillia and the independent variability of diagnostic features: H. V. Wilson.

Current research in organic chemistry at the University of North Carolina: A. S. Wheeler.

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At the business meeting President Metcalf announced that affiliation with the American Association for the Advancement of Science has been completed except for official notice from the Permanent Secretary of the Association.

The following officers were elected for the ensuing year: president, Jas. L. Lake, professor of physics, Wake Forest College; vice-president, Dr. J. H. Pratt, state geologist; secretary-treasurer, Bert Cunningham, professor of biology, Trinity College; additional members of the Executive Committee, H. R. Totten, University of North Carolina, R. N. Wilson, Trinity College, and F. A. Wolf, State College.

C. S. Brimley,
Acting Secretary

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CONTENTS

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"PROGRESSIVE EDUCATION" IN THE TEACHING OF PATHOLOGY[1]

In an article in the *Atlantic Monthly* of February, 1921, Mr. Stanwood Cobb describes "A new movement in education." The type of education which he considers has been given the name "Progressive Education." Although the article deals particularly with education in the primary grades, nevertheless, the question arises as to whether or not the principle which directs this movement may have application in more advanced technical education. A fundamental aim is to have the interest of the student aroused before his work is assigned. Although it might be presumed that the mere fact of a student's entrance into a school of medicine presupposes that his interest is sufficiently aroused to dictate the most active work in the furtherance of his technical training, yet all those who have taught in such schools know full well that such is not necessarily the case. The motives underlying the student's selection of a profession sometimes are extrinsic in origin; the purpose may have originated in the minds of parents or others. Again, the aim of the student may be different from the highest ideals of professional work. All too often the student regards certain of his subjects, particularly those of the preclinical years, as of little importance. Therefore, it becomes necessary to arouse interest on the part of a considerable number of students in any given class. Fundamentally, it might be assumed that were the teachers of the preclinical subjects to emphasize continuously the importance of these materials in the subsequent clinical work of the student that would be sufficient, but long experience in teaching pathology where this view has been particularly emphasized shows that even this

[1] From the department of pathology, school of medicine of Western Reserve University, Cleveland, Ohio.

method is not sufficient to attain the ideal. As a corollary to arousing interest on the part of children comes the proposition that "the best way to get the child to learn a thing is to make it want to learn that thing." These fundamentals of the progressive method of education in the earlier grades are attacked along four lines. They include (1) competitive games in which there is some opportunity for action, (2) the abandonment of the formal recitation, (3) a more flexible program, (4) correlation of book knowledge with the daily life of the child.

It is well understood that not only is primary education in an experimental stage but judging from the numerous attempts to elevate the standards of medical education, certainly this branch of technical training is also passing through a period of experiment. When one considers the reports presented before the Council on Medical Education in the spring of 1920 it becomes apparent that the same is true of the various subjects included in the medical curriculum. The question naturally arises as to how far the fundamental principles of progressive education may be applied to the subject of medicine as a whole or to any of its individual branches. The present communication deals only with the application to the course in pathology.

The principle of competition has been applied over years in the assignment of grades for work. In the minds of most teachers this is insufficient and often leads simply to intensive narrow work toward the attainment of high grades. Many students recognize in themselves a certain limitation of intellectual power and are not stimulated in any sense by the apportionment of grades. They recognize that all too often the students with highest grades are not necessarily the best practitioners or investigators. The same applies in the posting of excellent drawings or notes. Competition in actual practical work in pathology may, however, serve a useful purpose. In our own courses this is attempted by comparative efforts in actual work. Students are required to demonstrate to their classmates the fresh organs from recent autopsies. In certain instances they demonstrate microscopical preparations and the same principle is applied in the reporting of experiments. No grades are assigned for these efforts, but instead the attempt is made to stimulate the student's pride in his own attempts.

The abandonment of the formal recitation has met in our hands with the greatest success. Even with the utmost informality there was constantly before the student in ordinary recitations the desire to make a good impression on his teacher. It must be recognized, however, that in technical training there is in every subject a considerable content value and in the particular subject under consideration not only is this true but the aim of the teacher must be to stimulate the student to thinking logically in terms of medicine. Extremely successful in our work has been, under the stimulus of Mr. Cobb's article, the introduction of recitations conducted by the students. In the subject of special pathology this includes review recitations of the embryology, morphology, and physiology of organs and systems followed by similar recitations in pathologic disturbances. In adapting the method, the students elect for each recitation a director who is given sufficient time to prepare for this task. The students are requested to select their directors rather from the point of view of organizing ability and clearness and rapidity of thought than from the point of view merely of high class standing. This has resulted in a marked elevation of the standards of recitation. The results are shown in a greater cooperative spirit on the part of all concerned, a greater seriousness of purpose and attention and what appears to be a clearer understanding of the difficulties which each class faces. Naturally, such recitations must be closely supervised because of the necessity for maintaining accuracy. It might be objected that such a method leaves no room for the stimulation of the student's imagination. In practise, however, it is found that many questions brought up in the course of these informal discussions serve admirably in exciting speculation as to origins, process, results and relations of disease. Furthermore,

the lectures which are given can serve this important purpose equally as well as recitations. The informal recitation has the further advantage of permitting a better evaluation of the ability of the individual student than is possible with the more formal and more autocratic recitation conducted by the teacher. Inherent reticence of the student often prevents an answer to a teacher's question and yet permits of an adequate answer to the same question from one of his colleagues. The protection of the community and the maintenance of high standards in a school of medicine demand that the teacher form a proper estimate of the students' ability and this estimate can be materially aided by observation in the democratic and informal recitation.

A certain amount of flexibility in program is provided for in offering elective courses in the various divisions of special pathology. Considering the content value of a technical subject, it is difficult to adopt the program of flexibility to any very wide extent. Nevertheless, the principle can be applied without too great a sacrifice. Instead of assigning a certain number of slides for each day, a certain number of days can be given over to a particular subject; the total number of slides or other material can be indicated and the proportionate division of the work left to the student's personal wishes. Recognizing the fact that drawing illustrations of slides or other material has considerable value, nevertheless, flexibility may be adopted here. For example, the students of our present class have been told that fifty drawings are required in the subject of special pathology. Their selection of the subjects to be illustrated is of far more significance than is actual technical skill in drawing. No particular forms are given for the report of experiments and the method of presenting these reports gives the student complete freedom and serves as a guide to his grasp of the subject.

The correlation of the material acquired in pathology to the daily affairs of the student's and physician's life is a matter which has given the writer considerable concern. Fundamentally, this means the interpretation of pathology in terms of clinical medicine. The introduction of experiments to illustrate in animals these disturbances has been of the utmost vlaue. Simply performing the experiments is insufficient; they must be interpreted so as to demonstrate their application to human disease. The method adopted in our work has been described.[1] Even this proves insufficient and every opportunity must be taken to impress on the student the fact that the material he deals with comes from living patients. Correlation can also be approached by means of the clinical pathological conference, as adapted to the needs of students. In our courses eight periods of one and one half hours each are employed for this purpose. It is possible as a rule to cover two or three cases in each period. Two students of the third year class are required to present the history and differential diagnosis of a case that has recently come to autopsy. Following the discussion of this presentation, the organs from this patient are demonstrated by two other students either of the same class or of the second year class; this is succeeded by an attempt at correlation of symptoms and morphologic disturbance, as well as a discussion of the sources of error in clinical diagnosis. These exercises have proven to be most successful. In addition to these conferences the second year students at the end of the studies of the disease of the heart and of the diseases of the kidney take part in exercises which were first utilized with the cooperation of Dr. F. W. Peabody and are now being practised with the cooperation of Dr. R. W. Scott. These exercises have been described in detail[2] but they can be summarized by an illustration from a recent exercise. The students gathered in the

[1] Karsner, H. T., "The function of the experimental method in the course in pathology," *Boston Med. and Surg. Jour.*, 167: 511, 1912. Pearce, R. M., "The teaching of experimental pathology and pathological physiology to large classes," *Bull. Johns Hopkins Hospital*, 22: 249, 1911. Karsner, H. T., "Teaching the pathology of function," *Jour. Am. Med. Assn.*, 75: 361, 1920.

[2] Karsner, H. T., "The experimental method as utilized in the clinico-pathological conference," *Boston Med. and Surg. Jour.*, 170: 723, 1914.

amphitheater of City Hospital and demonstrated during the first hour the gross morbid anatomy of several fairly typical heart lesions. Recitation was then conducted by a student on the normal physiology of circulation. This was followed immediately by students' demonstrations of the effects in dogs of hydropericardium, of acute myocardial degeneration, of aortic stenosis and of aortic insufficiency. In line with the student's discussion of the normal functions of heart muscle Dr. Scott presented and discussed a few electrocardiographic tracings. After a brief rest the students then under Dr. Scott's direction examined three living patients exhibiting murmurs, thrills and cardiac arrhythmia.

It is hoped that as the experiment in progressive education is more widely applied to pathology the results will be improved, but even with the experience now at hand there is little doubt that this method has an application in pathology and that in so far as it has been attempted it has been proven to be eminently successful. Certainly, the idea is practicable and its success will depend upon the teacher's interest in the educational side of his subject, his willingness to grant as large a measure of freedom as possible to the students' own effort, his keenness in careful supervision and his confidence in the propriety of the idea.

Howard T. Karsner
Lakeside Hospital,
Cleveland, Ohio

A NOVEL MAGNETO-OPTICAL EFFECT

(*Further Investigations*)

In the former account of this novel effect, it was pointed out that a microscopic examination of the iron arc smoke deposited on a glass surface gave evidence of the existence of fine particles of iron compound arranged in short chain sections of bead-like relation.

It is now thought that this peculiar formation may have its origin in the outer envelope of the arc flame where the particles are formed, and where they are lined up around the arc stream by the circular magnetism surrounding the current conducted by the hot vapor stream of the arc. The particles, being magnetic, would tend to form chains or rings surrounding the arc. These would not be stable, however, but would float away as they became shattered by gas currents, and remain only as short lengths of particles held together. To throw light on this possibility, a small vertical, hollow cylinder of plaster of Paris open above was arranged with iron electrodes (for forming an arc) passing through its sides and meeting in its center. By passing the current of a storage battery giving about 50 volts through them in contact and separating them, an iron arc could be produced at will within the plaster cylinder. The dimensions of the cylinder were such that a microscope slide 3″ x 1″ could rest across the open upper end of the plaster cylinder, only partly closing it, the slide lying horizontally above the arc electrodes at a distance of about 3 cm. Such a slide could receive a layer of smoke on its under surface when the arc was formed below it. The microscope in that case showed only a confused deposit.

When, however, there was placed above the slide a strongly excited electromagnet with its poles resting on the upper sides of the slide or close thereto, such poles being about 3 cm. apart, a smoke deposit of a remarkable character was produced. Even as examined by the unaided eye in diffused light, there was decided evidence of a structure or striation. When, however, the microscope was used, with even comparatively low powers of about 300 to 400 diameters, there was disclosed a decided striation seemingly composed of brownish particles in strings extending over the slide and following the direction of the field. There was noted a surprising regularity in the distribution or spacing of the striæ, as if the surface was covered with fibers laid on systematically side by side.

There were, however, curious objects composed of small spheres (evidently globules of iron) strung together in a line of two, three, four or more, such spheres having no uniform size. Most of these iron globule groups lay, of course, in the field direction and were very

large relatively to the particles in the striation covering the most of the surface of the slide. But each of these straight settings of globules possessed a singular appendage, generally at one end only, but sometimes at both ends. It consisted of a brush-like tail composed of the brown filamentous chains of particles like those covering the slide as noted above. They gave the appearance of tufts, suggesting a growth of beaded fibers from the end of the string of globules. By focusing, these tufts or tails could be seen as projecting outward (upward) in an inclined direction. This means that the tufts did not lie on the slide surface, but sprang outward from the globule which carried it. The globule at the other end of the short chain (generally the largest in the line) was often to be seen as having a convergence upon it of the usually parallel striæ of the other parts of the slide, indicating clearly that the globules strung together were acting as small magnets with poles at each end, towards and from which poles, the convergence and divergence of the magnetic lines was indicated by the fine striæ of particles taking their direction.

The polariscope showed that the striated smoke layer caught on the slide has the same property of scattering or diffusing light (as plane polarized light) that the smoke oriented in the air by a magnetic field has, but, of course, the slide preserves the orientation and needs, to produce the results, no magnetic field after its formation or deposition. The slide covered with the striated smoke film is, in fact, a polarizer.

Examination between crossed Nicol's prisms (dark field) discloses the fact that the tufts of fine fibers carried by the rows of globules, show as luminous spots on the black field, clearly indicating that the groups or tufts have a polarizing effect if they are in proper relation to the rays passing through.

As was to be expected, any hollow vessel or enclosure capable of retaining the smoke from an iron arc can be used in demonstrating the original luminous phenomenon. A glass flask of from 1 to 2 liters is readily sensitized, as it were, by holding its mouth over an arc for a short time, allowing smoke from the arc to enter, and then corking the flask. It may then be used to show the effects by allowing a beam of light to traverse it while held in the field of a current-carrying coil. While this was being done, it was noticed by Dr. Hollnagel of the laboratory that when the coil was traversed by an A.-C. current of twenty cycles, the flask, when near the coil, gave the usual effect of increased luminosity of the smoke in its interior. When, however, the flask was removed from the coil a distance of several feet, the steady luminosity was replaced by a flickering which kept pace, not with the alternations of current in the coil, but with the cycles only. The flickering was, as it appeared, at the cyclic rate. This flickering was noted even at a distance of twelve feet from the coil, although the coil was but 7 inches in diameter and about 2 inches in axial direction. The flickering is a curious effect, and it is difficult to explain, especially the fact that it appears to keep time with the cycles and not the alternations of current. It points to some sort of magnetic retention or polarization of the iron particles of the smoke. They may even rotate or oscillate in obedience to the field fluctuations, but there is needed much more work of investigation as to the cause of the peculiar behavior. The experiment clearly shows that a very moderate field intensity suffices for lining up the particles in the air, and so producing the luminous effect.

Emphasis is again given to the fact of the extremely small amount of iron particles suspended in the air, capable of giving a decided effect.

ELIHU THOMSON

THOMSON LABORATORY,
LYNN, MASS.,
June 17, 1921

SCIENTIFIC EVENTS

THOMAS HARRIOT[1]

THE tercentenary of the death of Thomas Harriot, the mathematician and astronomer, occurred on July 2. Not only was he the most celebrated English algebraist of his time, but

[1] From *Nature*.

he was also one of the first astronomers in England to use a telescope, and, like Galileo, Fabricius, and Scheiner, was one of the early observers of the spots on the sun. Born at Oxford in 1560, he was a year older than Henry Briggs. He graduated from St. Mary's Hall, and became an ardent student of mathematics forty years before the inauguration of the first university chair of mathematics. At the age of twenty-five he entered the service of Sir Walter Raleigh, by whom he was employed in the survey of the newly founded colony of Virginia. The greater part of Harriot's life, however, was passed in the neighborhood of London, where he came under the patronage of Henry Percy, Earl of Northumberland, who gave him a pension and assigned him rooms at Sion House, which stands on the banks of the Thames opposite Kew. When the earl was confined to the Tower through the complicity of some of his family in the Gunpowder Plot, Harriot and two other mathematical worthies, Thomas Hughes and Walter Warner, often bore him company. They were known as "the three magi." Harriot appears to have passed an uneventful life, and at his death was buried in St. Christopher's Church, on the site of which now stands the Bank of England. A monument erected to his memory was destroyed in the Great Fire of 1666. As an algebraist Harriot is a connecting link between Vieta and Descartes. His "Artis Analyticæ Praxis" was not published until ten years after his death. The revival of his fame as an astronomer was due to von Zach, who, while on a visit to the Earl of Egremont in 1784, discovered some of Harriot's writings beneath a pile of old stable accounts at Petworth Castle; while the reduction of Harriot's observations of the comet of 1607 formed one of the first tasks of Bessel's astronomical career. Some of Harriot's manuscripts are in the British Museum.

THE INTERNATIONAL INSTITUTE OF AGRICULTURE

The president of the International Institute of Agriculture at Rome has transmitted to the Secretary of Agriculture, through the State Department, a copy of resolutions adopted in April, 1921, by the permanent committee of the institute, authorizing the conferring of the title "Donating Member" upon any person who makes a gift, donation, or contribution to the institute amounting in value to 10,000 Italian lire, which at normal rates of exchange is equivalent to about $2,000.

The permanent committee wished to demonstrate in a tangible manner the gratitude of the International Agricultural Institute toward all persons whose generous impulse prompts them to make gifts to it in money or in kind, thereby contributing toward the fulfillment of the mission intrusted to it.

The permanent committee has already named as a donating member Mr. Victor Vermorel, member of the National Academy of Agriculture of France and former senator, thus testifying to him its gratitude for a generous gift which he made to it recently.

The International Institute of Agriculture was established as the direct result of the efforts of David Lubin, a successful merchant of California, with the active support of the King of Italy, who foresaw the advantages which would accrue to agriculture, commerce, and industry from an international clearing-house for systematically collecting and disseminating official information supplied by the various governments of the world on agricultural production, consumption, movements, surpluses, deficits, and prices of agricultural products, transportation, plant and animal diseases and insect pests, rural credits and insurance, standard of living, wages and hours of labor on farms, cooperative organizations of farmers, legislation affecting agriculture, and similar information. The international treaty was drafted at Rome on June 7, 1905, and has since been ratified by more than 60 governments.

The institute survived the trying period of the World War and is now entering upon a period of expansion and increased usefulness. Its work benefits all peoples. In accordance with the recent action of the permanent committee, which is made up of delegates from the adhering governments and serves as a board of directors of the International In-

stitute of Agriculture, citizens of the United States and other countries who are in sympathy with the purposes of the institute have an opportunity to contribute to its support and development and to receive permanent recognition therefor as "donating members" by having their names and nationality and the date of their donation inscribed on a marble tablet which will be placed in a conspicuous position in the halls or vestibule of the marble palace occupied by the institute, situated in a beautiful park on an elevation overlooking the Eternal City. Such donations can be made either through the Secretary of Agriculture, the Secretary of State, or the American delegate to the International Institute of Agriculture, Rome, Italy.

THE EDINBURGH MEETING OF THE BRITISH ASSOCIATION

As has already been noted here the British Association meets at Edinburgh beginning on September 7. It last met in that city in 1892 under the presidency of Sir Archibald Geikie. The president, Sir Edward Thorpe, will address the association on aspects and problems of post-war science, pure and applied. An evening discourse will be given by Professor C. W. Inglis on a comparison of the Forth and Quebec Bridges, and there will be an opportunity to visit the former. Another discourse will be given on Edinburgh and oceanography by Professor W. A. Herdman, who, as president of the association at Cardiff last year, proposed a new exploration of the oceans like that of the *Challenger*. Sir Oliver Lodge will give the opening of the three lectures to the citizens on "Speech through the ether, or the scientific principles underlying wireless telephony"; Professor Dendy will lecture on "The stream of life"; and Professor H. J. Fleure on "Countries as personalities." A special lecture, arranged in collaboration with Section M (Agriculture), for agriculturists will be given by Dr. E. J. Russell on "Science and crop production." Hitherto all addresses of the presidents of sections have been formally read, and never discussed, but in the present program, the following addresses are announced to initiate debates: Sir W. Morley Fletcher, on the boundaries of physiology; Professor Lloyd Morgan, on consciousness and the unconscious, opening the newly established section of psychology; Dr. D. H. Scott, on the present position of the theory of descent in relation to the early history of plants; Sir Henry Hadow, on the place of music in a liberal education; and Mr. C. S. Orwin, on the study of agricultural economics. Other addresses will be given on the problems of physics by Professor O. W. Richardson, on the laboratory of the living organism by Dr. M. O. Forster, by Dr. J. S. Flett on experimental geology, by Professor E. S. Goodrich on some problems in evolution, by Dr. D. G. Hogarth on the application of geography, by Mr. W. L. Hichens on principles by which wages are determined, and by Professor A. H. Gibson on water power.

SCIENTIFIC NOTES AND NEWS

The South African Association for the Advancement of Science will meet next year at Lorenço Marques under the presidency of Dr. A. W. Rogers, director of the Geological Survey of the Union of South Africa.

The council of the Royal Society of Medicine made, on July 6, the first award of its gold medal to Sir Almroth Wright, F.R.S., in recognition of his services to medicine during the war. The medal is awarded for original discovery in medicine and other allied sciences, or for the practical application of the results of previous investigations of other scientists, or for the most valuable contribution in any other way towards the progress of the art and science of medicine, preventive medicine, or surgery.

It is reported that Professor Edouard Branly, of Paris, is to receive this year's Nobel prize for physics.

We learn from *Nature* that the French Société de Géographie has celebrated its centenary. There was a reception for delegates at the house of Prince Roland Bonaparte, president of the society, and M. Millerand,

president of the French Republic, presided at the opening meeting, a gathering at which explorers and geographers from various parts of the world were present.

Dr. E. J. Russell, director of the Rothamsted Experimental Station, has been appointed a foreign corresponding member of the Reale Istituto Lombardo di Scienze e Lettere di Milano.

W. M. Smart, chief assistant at the Cambridge Observatory, has been appointed to the John Couch Adams Astronomership, recently founded in Cambridge University under a bequest from the late Mrs. Adams.

The board of regents of the University of Michigan has adopted congratulatory and laudatory resolutions in recognition of the services of Professor W. W. Beman, who has for fifty consecutive years been a member of the literary faculty and for thirty-four years head of the department of mathematics.

Professor Herbert E. Gregory, of Yale University, director of the Bishop Museum in Honolulu, has been awarded life membership in the National Geographic Society for his original contributions to geographic science.

Henry E. Allanson has been appointed assistant to the chief of the bureau of plant industry, Department of Agriculture. He is a graduate of Cornell University, and came to the bureau in 1911.

Professor Alexander M. Gray, director of the school of electrical engineering of Cornell University, has been granted leave of absence for the year 1921–22, because of ill health.

Dr. Walter Long Williams, professor of obstetrics and research in the diseases of breeding animals, has retired from the faculty of the New York State Veterinary College at Cornell University. Dr. Williams was a member of the original faculty of that college. For eighteen years he was professor of veterinary research and obstetrics and for the last seven years has devoted his time to the study of the diseases of breeding animals.

Dr. Edward Phelps Allis, Jr., has returned to his biological laboratory at Mentone, France, after some nine months in America.

An expedition on behalf of the State University of Iowa to the gulf coast of Florida was conducted by Professor H. R. Dill in the latter part of May. A collection of marine fishes was made which will be mounted for the museum.

The Hugo Müller lecture of the Chemical Society, entitled "The natural photosynthetic processes on land and in sea and air, and their relation to the origin and preservation of life upon the earth," will be delivered by Professor Benjamin Moore on June 16.

The geological library of 4,000 volumes and 15,000 geological specimens collected by the late Professor H. P. Cushing and his father-in-law, the late S. G. Williams, have been presented to Western Reserve University by Mrs. Cushing.

A monument in memory of the French chemist, Adolphe Wurtz, was unveiled at Strasbourg on July 5.

The death is announced at eighty-three years of age, of Professor Viktor von Lang, formerly professor of physics at Vienna.

The Mathematical Association of America and the American Mathematical Society will hold their summer meetings at Wellesley College, September 6–7 and 7–9, respectively. Two joint sessions will be devoted to a symposium on "Relativity." On the afternoon of the seventh, Professor Pierpont, of Yale University, will give a paper entitled "Some mathematical aspects of the theory of relativity," while on the forenoon of the eighth, Professor Lunn, of the University of Chicago, will speak on "The place of the Einstein theory in theoretical physics."

The regents of the University of California have granted $20,000 from the campus improvement fund to the Lick Observatory for the improvement of the grounds and buildings at Mount Hamilton.

The American Pharmaceutical Association

has available a sum amounting to about $360, which will be expended after October for the encouragement of research. Investigators desiring financial aid in their work should communicate before September 1 with Professor H. V. Arny, chairman A. Ph. A. Research Committee, 115 West 68th St., New York, giving their past record and outlining the particular line of work for which the grant is desired.

We learn from the *Bulletin* of the Bureau of Fisheries that the first meeting of the International Committee on Marine Fishing Investigation was held at Montreal, on June 23, at the call of the Canadian representatives. The members present were: Representing Canada—W. A. Found and A. G. Huntsman; representing Newfoundland—James Davies; representing the United States—H. F. Moore, R. E. Coker and H. B. Bigelow. The committee adopted resolutions recommending the coordination of the statistical data collected by the several countries represented in respect to the offshore fisheries, particularly those for cod and haddock; that studies of the cod, including tagging experiments, be undertaken; and that the methods of marine research of the several countries be standardized. Tentative steps were taken toward giving effect to these recommendations. The next meeting of the committee will be held in Boston, on November 4.

A conservation conference, called by the Secretary of Commerce, met at the United States fisheries biological station, Fairport, Iowa, from June 8 to 10, 112 delegates having registered. The states represented were Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, New York, Ohio, Pennsylvania, South Dakota, Wisconsin, and the District of Columbia. The attendance consisted of fishermen, fish dealers, button manufacturers, engineers, sanitarians, conservationists, state and national fishery officials, and biologists interested in the study and conservation of the life of fresh waters. A number of resolutions were adopted advocating various measures for the conservation of interior waters for economic, æsthetic, and recreational purposes.

A correspondent writes: "The Bureau of Economic Geology and Technology of the University of Texas faces the probability of a total suspension of its activities for the next two years, on account of the elimination of its appropriation by the university authorities, as a result of the reduced appropriation allotted to the university by the Finance Committee of the State Legislature, which is now in session. There is still a possibility that some money may be assigned to the bureau from the contingent fund of the university, and this may prevent its entire suspension. This bureau has produced in the last few years a considerable amount of stratigraphic and paleontological work, and is at present the most important agency in advancing the knowledge of the geology of Texas. During 1919–1921 it produced 14 bulletins, aggregating 1,979 pages. The publication of several important works will be indefinitely postponed in case of elimination of the appropriations. In addition to its purely scientific activities, the bureau maintains a department for the examination of well samples, a testing laboratory for structural and road materials, and a chemical laboratory which is carrying out an extensive research program on lignite, oils and clays."

The *American Journal of Insanity*, Johns Hopkins Press, Baltimore, will hereafter be the official organ of the American Psychiatric Association (till now the American Medico-Psychological Association) and will be published as the *American Journal of Psychiatry*.

There has been organized at the University of Minnesota and the affiliated Mayo Foundation a branch of the Society for Experimental Biology and Medicine which will be known as the *Minnesota Branch* of the society. At the present time there are 23 members of this society in the University of Minnesota. It is planned to arrange regular meetings throughout the academic year for the presentation and discussion of original papers falling within

the general field of experimental biology and medicine. Abstracts of the papers presented will appear in the *Proceedings* of the parent society.

THE graduate women in the science departments at Cornell University have recently organized a sorority under the name of Sigma Delta Epsilon. The membership is primarily limited to women engaged actively in research work; honorary membership has been extended to several women who have gained recognition in the scientific world. The society will have a house at which the members may live while at Cornell. The organization at present consists of twenty-five active members and eight honorary members. The officers are: Adele Lewis Grant, *president;* Katherine Van Winkle, *vice-president;* Josephine Overton Souders, *secretary;* Hazel Elizabeth Branch, *treasurer.*

UNIVERSITY AND EDUCATIONAL NEWS

ABOUT $400,000 of the $500,000 appropriated for building purposes at the University of Iowa by the last general assembly is to be expended for the erection of the first units of a new chemistry building. When completed the building will cost $1,000,000.

DR. C. L. METCALF, for the past seven years professor of entomology in the Ohio State University, has resigned to accept the position of professor of entomology and head of the department of entomology in the university of Illinois.

HERSCHEL C. SMITH, formerly deputy state highway engineer of Oklahoma, has been appointed assistant professor of highway engineering and highway transport at the University of Michigan, from which institution he graduated in 1913.

DR. ALFRED H. W. POVAH, assistant professor of forest botany and pathology in the New York State College of Forestry since 1918, has resigned to accept the position of associate professor of plant pathology and associate pathologist in the Alabama Polytechnic Institute.

CLEVELAND P. HICKMAN, M.A. (Michigan), has been appointed instructor in zoology in West Virginia University.

DR. JOHN HOWLAND, professor of pediatrics at the Johns Hopkins Medical School and pediatrician-in-chief of the Johns Hopkins Hospital, has declined the offer of the Medical School of Harvard University to become professor of children's diseases at that institution. He will remain at Johns Hopkins.

DISCUSSION AND CORRESPONDENCE

A LIVING GALVANOMETER

THAT differences in electrical potential are produced by protoplasmic activity is a well-known fact. This is especially true of muscular activity. The existence of electrical currents in tissues was proved by Schweiger in 1824 and by Nobili, who discovered the galvanometer. The string galvanometer was first used to detect these currents, although it was reasonably believed that such currents were present before the galvanometer was discovered. Such evidence was correctly given in a more rudimentary way by Galvani and Volta. With the introduction of the various kinds of galvanometers these electrical currents were easily demonstrated. At the present the various modifications of Einthoven's galvanometer are used in detecting electrical currents produced by the activity of various muscles and especially the heart and in obtaining electrocardiograms. In fact it is a very accurate method of obtaining a clinical picture of the condition of the heart in man.

The discussion and demonstration of the production of electrical currents by living organisms and especially man, never fail to fascinate students, however teachers have found themselves handicapped by the lack of a suitable galvanometer. In laboratory experiments of this kind, such as Galvani's experiment and the rheoscopic frog experiment an outside stimulus is necessary to demonstrate this. In the experiment where the sciatic nerve of a muscle nerve preparation is laid across the beating heart, the results are very

striking, but the demonstration of electrical currents in the human body would be usually regarded as impossible without a galvanometer. These difficulties are solved by the rather simple experiments cited below.

Recently, while making a nerve muscle preparation, the thigh muscles of the left leg of the frog were removed and the nerve on the same side isolated but not sectioned. The body was well moistened with physiological saline and lay on a glass plate which was also well moistened. The toes of the left foot were held in the left hand, while forceps, held in the right hand, were accidentally placed upon the body of the frog. Immediately a violent contraction of the muscles of the left leg occurred. This was so unusual that we investigated this further. The same results were obtained repeatedly. It must be noted here that one metal was used instead of two as in Galvani's experiment, and in place of the other metal the human hand was used. The current stimulating the nerve might have been due to the difference in potential between the metal and the hand, and for that reason we substituted the right finger for the metal previously used and obtained the same results. We therefore concluded that the nerve was stimulated by the action current of the human body, the electrodes being the fingers of the right and left hands and the indicator or the galvanometer being the contractions of the frog's muscles.

The same experiment was tried on a number of frogs and in every case we obtained the same results, although more striking in some preparations than in others. We found that by making contact with any part of the frog's body or even the saline solution on the plate the muscles contracted.

When a non-conductor was interposed between the toes and the hand we found that no contraction took place. When a non-conductor such as wood was used for the right electrode no contraction took place. We at first thought that the action current involved was that produced by the beating human heart, but the absence of the rhythmical contractions in the muscles of the frog negates this.

It has been noted in some cases that the contractions were very violent, even tetanic, and immediately afterwards hardly noticeable. We have no explanation to offer for this other than the varying electrical currents in the body.

GEORGE G. SCOTT,
JOSEPH TULGAN

DEPT. OF BIOLOGY,
COLLEGE OF THE CITY OF NEW YORK

AN EXCEPTION TO DOLLO'S LAW OF THE IRREVERSIBILITY OF EVOLUTION

IT has been claimed that most cases of apparent reversion to a primitive type in specialized organisms—such as the occurrence of three toes in the horse that Cæsar rode, or a reversion to the primitive number of petals in flowers, etc.—are to be explained simply as additions of supernumerary parts, comparable to polydactylism, or the addition of supernumerary digits to those normally present in man, cats, etc. Since so many cases of an apparent reversing of the evolutionary process apparently have to do with the number of the various structural features present, and are therefore open to the objection that we may be dealing with merely an addition of supernumerary parts to those normally present, it may be of some interest to cite a clear case of reversion to the primitive condition in structures in which there can be no possible question of the addition of supernumerary parts.

In the fruit fly *Drosophila*, as is true of practically all Diptera, there has been such a marked specialization of the metathoracic region that the sclerites of this segment of the thorax have been profoundly modified and reduced, especially in the tergal region; and the metathoracic wings have been reduced to mere knobbed threads, the halteres, which would not be recognized as the vestiges of wings, if we did not know that they are modified wings from their mode of development, etc. Dr. Morgan, however, has recorded a mutant of *Drosophila* which he describes as having a "double thorax," apparently not realizing the true nature of the parts in the

mutant in question. The metathorax of this mutant has apparently reverted to a condition approximating that occurring in the ancestors of the Diptera, in having a well-developed metanotum and other metathoracic sclerites, while the wings of this segment of the thorax, instead of being mere knobbed threads as in practically all Diptera, have become developed as comparatively broad wings, with a well-defined venation. I am hoping to be able to make a careful anatomical study of the thoracic structures of this mutant in the near future, and have offered this brief account merely as a preliminary note of an investigation which will be given more in detail in a later publication.

G. C. Crampton
Massachusetts Agricultural College,
Amherst, Mass.

SCIENTIFIC BOOKS

JONSTON'S NATURAL HISTORY OF FISHES

Through the courtesy of Mr. Carl L. Hubbs of the University of Michigan, I have been able to examine a very rare book, seldom recorded in bibliography, the particular edition apparently not at all.

Its author is John Jonston, or as he writes it, Johannes Jonstonus, M.D., and its title page reads:

> Johann Jonstoni | Historiae Naturalis | de | Piscibus | et Cetis | Libri V | tabulis quadraginta septem | ab illo celeberrimo | Mathia Meriano | aeri incisis ornata | ex scriptoribus tam antiquis | quam recentioribus | maxima cura collecti | quos | ob raritatum denuo | imprimendos suscepit. Franciscus Josephus Eckerbrecht | Bibliopola Heilbrunnensis | MDCCLXVII.

Following this and bound with it is another volume, with the same title except for the words "de Exangibus Aquatilis Libri IV., tabulis viginti." This treats of invertebrates.

As this work bears the nominal date of 1767, subsequent to the "Systema Naturæ," it merits consideration in the interests of stable nomenclature.

I find that it is throughout a compilation from earlier authors, the latest of which is Piso's edition of Marcgrave's "Historia Naturalis Brasiliæ," printed at Leyden in 1648. The sources of information are carefully and apparently accurately given in side-headings. There is some evidence of a system of classification. Book first, for example, treats of marine fishes. Title of those which are pelagic, Heading 1, of scaly pelagic fishes, and Article 1, "de Asellis" of various "cods." Most of the forms mentioned are indicated by Latin nouns, the Greek form often added, and occasionally a descriptive adjective gives a binomial form. I find, however, no trace of a binomial system of naming; the word species I have not noticed and the word genus, occasionally used, has no technical significance, meaning merely "kind."

The names used by Jonston could not enter scientific nomenclature even if the date of the publication were subsequent to 1758, a matter which may be open to doubt.

In Bosgoed's "Bibliotheca Ichthyologia et Piscatoria," 1874, page 9, is recorded a treatise by J. Jonston, with a similar but more extended title, said to be in five parts in two divisions ("dln.") with the dates 1650 to 1653, issued at Frankfort on the Main.

Apparently the volume before me is a reprint of the second "dealing" of this general work, as it bears a different date and the name of a different publisher. Bosgoed speaks of a new edition in Amsterdam in 1718, and an edition in Dutch in Amsterdam in 1660, translated from the Latin by M. Grausius. In advance proof sheets of the second edition of Dean's "Bibliography of Fishes," references are given to about a dozen editions in Latin or Dutch. One of these is dated 1677, but none 1767.

It may be questioned whether the date "MDCCLXVII" given on Libri IV. and V. alike is not a misprint for MDCLXVII. The appearance of the book and the absence of reference to any author later than 1648, would point in this direction. In any event, the names merit no consideration from systematists as, if really issued in 1767, it is merely an unmodified reprint of a pre-Linnæan,

non-binomial, unsystematic popular compilation.

The volume is effusively dedicated to "Wilhelmo VI Hessio Landgravio," whose titles and virtues his "devotus cliens" expounds at length.

DAVID STARR JORDAN

SPECIAL ARTICLES

ON A METHOD OF ESTIMATING THE NUMBER OF GENETIC FACTORS CONCERNED IN CASES OF BLENDING INHERITANCE

IN the early days of rediscovered Mendelism Bateson[1] suggested the idea that what was then known as blending inheritance might be a variety of Mendelism in which dominance was wanting, but in which several or many independent factors were involved. This suggestion was found to be in good agreement with much experimental work on quantitative characters subsequently carried on by Nilsson-Ehle, Tammes, Emerson and East, and others. It is now generally accepted as the most probably correct explanation of all varieties of intermediate or blending inheritance. Accepting this as a working hypothesis, have we any means of discovering *how many* factors are involved in cases of blending inheritance? Surely the number must be very different in different cases.

Noteworthy features of blending inheritance are the following: (1) F_1 is intermediate between the pure parental races, but not more variable than the more variable parent. (2) F_2 is likewise intermediate in character but is *more variable* than F_1 or either parent. (3) In F_3 and subsequent generations the variability decreases from the maximum suddenly attained in F_2.

In all varieties of inheritance, whether typically Mendelian or blending, the maximum variability is to be found in the F_2 generation. In ordinary Mendelian inheritance we are able to detect the number of genetic factors concerned by the number of phenotypes which are distinguishable in F_2 and by their numerical proportions. The F_1 generation is in strong contrast with the F_2 generation to which it gives rise, for F_1 is of a single type, if the parent races were pure.

In blending inheritance also, it is the F_2 generation which affords a clue to how many genetic factors are involved, not by the formation of clearly distinguishable types (for there is but one), but *by the amount of the variability of that single type in F_2 as compared with F_1.*

To make this clear, let us consider the numerical series commonly employed, by expositors of the multiple factor hypothesis, for explaining the increased variability of F_2 in blending inheritance. If two pure races differ from each other by a single genetic factor (which does not show the phenomenon of dominance), and if these two pure races are crossed, F_1 will be intermediate. F_2 will also be intermediate in part, but the parental classes will also reappear, and there will thus be three distinguishable classes in F_2, which correspond with the two parental types and the F_1 type respectively. The classes will be numerically as 1 : 2 : 1, as in the familiar case of the blue Andalusian fowl.

Now suppose that the pure parent races dif-

TABLE I

F_2 Distributions in Size Classes, when Inheritance is Blending and Involves from One to Six Independent and Equivalent Factors

Factors	Class Magnitudes (Top Row) and Frequencies (Below)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	Standard Deviation
1	1						2						1	$\sqrt{18}$
2	1			4			6			4			1	$\sqrt{9}$
3	1		6		15		20		15		6		1	$\sqrt{6}$
6	1	12	66	220	495	792	924	792	495	220	66	12	1	$\sqrt{3}$

[1] Report I. to the Evolution Committee of the Royal Society, London, 1902.

fer by two independent but equally powerful factors, neither of which shows dominance. F_1 will again be intermediate but of a single type and not more variable than either pure parent race. But F_2, by recombination of the two differential factors, will now consist of five graded types, two of which correspond with the parental types, while the remaining three are found in the intervening region at equally spaced intervals. If the several graded types are readily distinguishable one from another, they will be found to occur in the proportions 1 : 4 : 6 : 4 : 1. But if the types are so close together in appearance as not readily to be distinguishable, the distribution will resemble a probability curve.

Further, if three independent but equivalent factors are involved in a cross where dominance is wanting, the F_2 classes will number seven and their frequencies will be as 1 : 6 : 15 : 20 : 15 : 6 : 1.

Now, suppose that in these several hypothetical cases, the character under investigation is size, and that the amount of difference in size between the parents is in every case the same; let us say for convenience, 12 units (inches, pounds, or whatever the case may be). Then the several classes of individuals of which F_2 is composed will have the class magnitudes and frequencies shown in Table I.

For distributions, such as those shown in Table I., we can readily calculate standard deviations, which measure the variability of each array. See the last column of Table I. It will be observed that the standard deviation falls off rapidly as the number of factors involved increases. Inspection of the column headed "standard deviation" in Table I. will allow one to arrive at the law of decrease of the standard deviation with corresponding increase of factors. It is evident that as the number of factors is doubled, the standard deviation is halved under the radical sign. In other words, *to reduce the standard deviation by one half, the number of factors must be increased four fold.* With this point in mind one can extend as far as is desired the columns in Table I. headed "factors" and "standard deviation."

In Table I. the difference between the parents is assumed to be 12 units and the standard deviation is expressed in terms of those units. To give the table a general form, we might suppose the difference between the parents to be one unit. The standard deviation would then be only one twelfth as great. It is so given in Table II., wherein only the columns "factors" and "standard deviation" are entered from Table I.

TABLE II

Standard Deviation of F_2 Expressed in Per Cent. of the Difference between the Parent Races

Factors	Standard Deviation	Factors	Standard Deviation	Factors	Standard Deviation	Factors	Standard Deviation
1	35.35	13	9.75	44	5.32	144	2.94
2	25.00	14	9.50	48	5.10	160	2.79
3	20.41	15	9.12	52	4.87	176	2.66
4	17.67	16	8.81	56	4.75	192	2.55
5	15.81	17	8.53	60	4.56	208	2.43
6	14.43	18	8.33	64	4.40	224	2.37
7	13.33	20	7.90	68	4.26	240	2.28
8	12.50	24	7.21	72	4.16	256	2.20
9	11.78	28	6.66	80	3.95	272	2.13
10	11.18	32	6.25	90	3.60	288	2.08
11	10.64	36	5.89	112	3.33	320	1.97
12	10.20	40	5.59	128	3.12	384	1.80

In the foregoing discussion, it has been assumed that the parent races were completely homozygous and so deviod of *genetic* variability. If this were true of the parents, it would also be true of F_1. In that case whatever variability was exhibited by the parents or F_1 would be *non-genetic*. Under like environment F_2 would be expected to show a like amount of non-genetic variability. Hence in estimating the genetic variability of F_2 one would have to deduct from the total observed variability of F_2 an amount equal to the observed (non-genetic) variability of F_1.

In practise one would proceed as follows. First find the difference between the standard deviations of F_1 and F_2. Divide this by the difference between the parental means (the respective means of the two pure parent races). Multiply the quotient by 100. Now look in Table II. for the nearest corresponding number in the column "standard deviation." Op-

posite this will be found the number of factors indicated.

Let us take a specific example. Emerson and East[2] (1913, p. 59) studied (among other quantitative characters) the inheritance of weight of seed in crosses of two varieties of maize. The mean weight of a seed in one parent variety was 2.7 grams; in the other variety, it was 8.3 grams, *a difference of 5.6 grams.* The seeds of F_1 plants had a mean weight of 4.6 grams and a *standard deviation in weight of .639 grams.* The mean seed weight of F_2 plants was 6.0 grams and the *standard deviation for F_2 was 1.17 grams.* The difference between the standard deviations of F_1 and F_2 is $1.17 - .639 = .531$ grams. This is to be divided by the difference between the parental means, which was 5.6 grams. Now $.531/5.6 = .0948$, which multiplied by 100 gives 9.48 per cent. Looking in the column "standard deviation" in Table II., we find the indicated number of factors to be 14.

Emerson and East made two other crosses between these same varieties of maize, but used different individuals as the parents in each cross. The results for the other two crosses may be compared with the case just discussed to test the reliability of the method. In one case, the standard deviation of F_2 was 1.089, making the difference between F_1 and F_2 .45. Now $(.45/5.6) \times 100 = 8.03$ per cent., which corresponds with the result expected from about 19 factors. In the other case the standard deviation of F_2 was 1.23, making the difference between F_1 and F_2 .591. But $(.591/5.6) \times 100 = 10.55$ per cent., indicating 11 factors. The three different lots of F_2 individuals thus indicate the factorial differences between the parents crossed to have been in one case, 11 factors; in a second case, 14 factors; and in a third case, 19 factors. It is rather probable that the parent races were not homozygous, maize rarely is. But the indicated mean difference between the parent races would be about 15 factors.

It is evident that the method has some serious limitations in its applicability. It applies perfectly only to cases in which the parents are genetically pure, that is, are homozygous for all factors affecting the character under investigation. Such material is rarely met with even in self fertilizing plants. If either of the parent races is in any degree variable genetically (heterozygous), F_1 will be variable in like degree. This will tend to *decrease* the difference in variability between F_1 and F_2 and so to *increase* the indicated number of factorial differences between the parents. This difficulty can be offset in part by raising an F_2 generation derived from all classes of F_1 in the proportion of their occurrence. It is obvious that when a variable F_1 is obtained, various classes of F_1 individuals should be tested as to their genetic character, and if they are found to be genetically diverse, each should have proportionate representation in the F_2 population.

The theory of multiple factors in blending inheritance assumes that each factor is equal to every other factor in its influence on the character affected. It is improbable that this is strictly true, but no other assumption will

[2] "The inheritance of quantitative characters in maize," *Res. Bull.*, 2, Agr. Exp. Station, Nebraska.

TABLE III

Estimation of the Number of Genetic Factors Influencing Weight Involved in Crosses of Certain Races of Rabbits

Cross	Standard Deviation F_2	Standard Deviation F_1	Difference between F_2 and F_1	Difference between Means of Parent Races	Factors Indicated
Polish × Himalayan	233	212	21	471	56
Himalayan × Flemish	230	162	68	1,725	80
Polish × Flemish	257	198	59	2,196	176

permit of a general treatment of blending inheritance. If one attempts to apply to each case a scheme of specially weighted factors, as Punnett has done for size inheritance in fowls and rabbits, he proves nothing except the fact that a factorial explanation of his results is possible, for by properly weighting factors and assuming that some inhibit the action of others, one can fit to his observations a scheme involving either few or many factors. If one factor really has an influence greatly superior to that of other factors in a case of blending inheritance, this will be seen in the production of asymmetrical or multimodal variation polygons in F_1 and F_2. If, when adequate numbers are produced, the variation curves of F_1 and F_2 are both smooth, it is certain that no genetic factor of predominant influence is involved in the case, but that several or many factors substantially equal in influence are concerned. Whether many or few can perhaps be ascertained by the method suggested in this paper.

I have recently applied it in the study of weight inheritance in crosses between races of rabbits differing in size, with the following results. Three races of rabbits were crossed in all possible ways. The average size of the smallest race, Polish, was 1,404 grams; of the second race, Himalayan, it was 1,875 grams; of the third race, Flemish, it was 3,600 grams. The number of factors indicated as differentiating the races in weight is in the order of magnitude of the differences between the races. See Table III. But the number of factors indicated as differentiating the smallest race from the largest (Polish from Flemish) is apparently too great, since it exceeds the sum of the differences in number of factors indicated as existing in the other two crosses. It is perhaps not to be expected that results more than approximately correct would be given by this method, unless fairly large numbers of both F_1 and F_2 individuals have been studied. In the rabbit crosses, the numbers of F_1 individuals studied were 16, 25, and 27, respectively. The F_2 numbers were 50, 62, and 112. The results obtained are sufficient to indicate the probability that in the Polish $\times$ Himalayan cross, 50 or more factors are involved, and that the crosses with the largest race, Flemish, involve two or three times as many factorial differences. A fuller discussion of this case will be published later.

W. E. Castle

Bussey Institution,
May 27, 1921

THE UTAH ACADEMY OF SCIENCES

The fourteenth annual convention of the Utah Academy of Sciences met in the physics lecture room of the University of Utah, Salt Lake City, on Friday evening, April 1, 1921, and continued for three sessions, closing Saturday afternoon with a business session at which the following officers were elected for the ensuing year.

President, Dr. Frank L. West, Utah Agricultural College, Logan, Utah.
First Vice-president, Professor Hyrum Schneider, University of Utah, Salt Lake City.
Second Vice-president, Professor Carl F. Eyring, Brigham Young University, Provo.
Secretary, A. O. Garrett, East High School, Salt Lake City.
Corresponding Secretary, C. Arthur Smith, East High School, Salt Lake City.
Councillors, Professor Harold R. Hage, University of Utah; Dr. M. C. Merrill, Utah Agricultural College, Logan; R. A. Hart, U. S. Reclamation Service, Salt Lake City.

Twenty-seven new members were added to the academy's roll of membership, making the largest increase in any one year in the history of the academy.

The academy voted unanimously to support the following resolutions:

Whereas: There is a greatly increased appreciation and use of the recreation and scenic resources of Utah to which an abundant supply of wild life is of great importance in furnishing an opportunity for nature study, fishing and hunting;
Whereas: The maintenance of proper forest conditions is necessary for the preservation and production of fish and game;
Whereas: Proper measures to insure a continued supply of fish and game must be based on a scientific knowledge of biological factors involved;
Therefore, be it resolved, That the Utah Academy of Sciences:
1. Emphasize the close relationship between our forests and fish and game conservation.
2. Endorse the recognition by the Forest Service that the fish, game and wild life on the National Forests are valuable resources to be preserved and maintained.
3. Cooperate with the sportsmen, the State Game Department, and Federal departments in order that proper measures to perpetuate the fish and

game be undertaken and that the general public, especially the youths, be informed regarding our wild life and the necessity for its protection.

WHEREAS: The rapid increase in population of the United States and Canada with its consequent use of agricultural and forest land is threatening the extinction of many native species of plants and animals, and

WHEREAS: The preservation of such native species is greatly to be desired, be it

Resolved: That the Utah Academy of Sciences endorse the work of the Ecological Society of America in the movement for the preservation of natural conditions in the United States and Canada.

Resolved: That it is particularly important that areas with typical plant and animal communities in different states of the union and the provinces of Canada be preserved and allowed to go on with their natural successional changes for the benefit not only of students who are interested in these subjects at the present time, but also and more particularly for future generations.

Resolved: That this Academy hereby requests the National Research Council to take cognizance of this important subject and requests said National Research Council to aid in whatever manner may be possible the work of the Ecological Society of America in securing vegetation and animal preserves and sanctuaries for the furtherance of scientific study.

Resolved: That a copy of these resolutions be forwarded by the corresponding secretary to Dr. C. E. McClung, chairman of the Division of Biology and Agriculture of the National Research Council.

WHEREAS: It is recognized that the timber supply of the nation is rapidly becoming depleted;

WHEREAS: The forest resources are of the greatest importance in the economic and industrial development of Utah and of the entire nation;

WHEREAS: The maintenance of proper forest conditions on important watersheds is conducive to a regular and continued stream flow and an adequate supply of pure water so essential for domestic, hydro-electric and irrigation use;

Be it resolved: That the Utah Academy of Sciences strongly endorses the conservation of forests to the extent of maintaining all potential forest land in a highly productive condition. With this purpose in view, we therefore, strongly urge the adoption of a national forest policy for the entire nation similar to that proposed in H. R. 15,327, introduced in the 3d Session of the 66th Congress, commonly known as the "Snell Bill."

Therefore, be it further resolved: That the Corresponding Secretary be instructed to transmit copies of this resolution to the members of Congress from Utah.

The following papers were read at the three sessions of the convention.

FRIDAY EVENING, APRIL 1

Symposium of Forests Conservation in Utah

Making the forest of Utah a permanent resource, C. F. CORSTIAN, U. S. Forest Service, Ogden, President of the Academy.

Fungus forest tree diseases of Utah, A. O. GARRETT, East High School, Salt Lake City.

Forest and fish and game conservation, S. B. LOCKE, U. S. Forest Service, Ogden.

Forests in relation to climate and water supply of Utah, J. CECIL ALTER, U. S. Weather Bureau, Salt Lake City.

SATURDAY A.M.

Analytical distillation of shale oil, M. J. GAVIN, U. S. Bureau of Mines, Salt Lake City.

The use of the microscope in ore dressing, R. E. HEAD, U. S. Bureau of Mines.

Destructive distillation of oil shale, L. C. KARRICK, U. S. Bureau of Mines.

Chemistry of the volatilization process, THOMAS VARLEY and C. M. BOUTON, U. S. Bureau of Mines.

Metallurgy of the volatilization process, C. C. STEVENS, University of Utah.

Function of steam in retorting oil shales, M. J. GAVIN, U. S. Bureau of Mines, and J. J. JAKOWSKY, University of Utah.

Reduction of copper from chloride fumes, R. H. BRADFORD, University of Utah.

SATURDAY P.M.

Decomposition of green manure at different stages of growth, THOMAS L. MARTIN, Millard Academy.

The normal temperature as a function of the time, elevation above sea level and the latitude, FRANK L. WEST, Utah Agricultural College.

Vitamines in relation to nutrition, W. E. CARROLL, Utah Agricultural College, Logan.

Relation of precipitation to height growth of forest tree saplings, CLARENCE F. KORSTIAN, U. S. Forest Service.

A twelve o'clock luncheon was given to the members of the academy and their friends at the university dining hall under the efficient direction of Miss Lucy Van Cott, dean of women, University of Utah. Dr. Frank L. Harris, of the Agricultural College, spoke at the luncheon on the general topic of scientific research, emphasizing the importance of stimulating an appreciation of its results in the public mind.

C. ARTHUR SMITH,
Corresponding Secretary

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION H—ANTHROPOLOGY

At the Chicago meeting of Section H—Anthropology—the following officers were nominated:

Vice-president (1921), A. E. Jenks, Minneapolis, Minn.

Secretary (Jan., 1921–Dec., 1924), E. A. Hooton, Cambridge, Mass.

The following members of the Sectional Committee were elected: B. Laufer (Jan., 1921–Dec., 1924), Chicago, Ill.; F. C. Cole (Jan., 1921–Dec., 1922), Chicago, Ill.

The Sectional Committee is constituted as follows: A. E. Jenks, chairman, Minneapolis, Minn.; E. A. Hooton (Jan., 1921–Dec., 1924), Cambridge, Mass.; Aleš Hrdlička (Jan., 1920–Dec., 1923), Washington, D. C.; Berthold Laufer (Jan., 1921–Dec., 1924), Chicago, Ill.; R. J. Terry (Jan., 1920–Dec., 1921), St. Louis, Mo.; F. C. Cole (Jan., 1921–Dec., 1922), Chicago, Ill.; Clark Wissler (1921), from the American Anthropological Association, Washington, D. C.; J. Walter Fewkes (1921), from the American Anthropological Association, Washington, D. C.

The following papers were read and discussed:

The practical value of anthropology to our nation: A. E. Jenks, University of Minnesota.

The grouping of Piman languages upon a phonetic basis: J. A. Mason, Field Museum of Natural History.

A project for the study of race mixture in the United States: E. A. Hooton, Harvard University.

The peopling of Asia: A. Hrdlička, U. S. National Museum.

The influence of sex and stock upon the pubic bones: T. Wingate Todd, Western Reserve University.

Variations in the weight of new-born children with particular reference to racial differences; comparative growth of premature and normal children: E. E. Scammon, University of Minnesota.

A bird's-eye view of American languages north of Mexico: E. Sapir, Geological Survey, Canada.

The scaphoid type of scapula: W. W. Graves, St. Louis, Mo.

The native culture of the Czecho-Slovak people and its relation to other European cultures: K. Chotek, Ethnographical Museum, Prague.

The present state of anthropological research in the Philippines: F. C. Cole, Field Museum of Natural History.

The relative dating of Aztec and Pueblo Bonito ruins, by growth rings on the timbers: A. E. Douglass, University of Arizona.

Aztalan: S. A. Barrett, Milwaukee Public Museum.

Anthropology at the Pan-Pacific Congress: Clark Wissler, National Research Council.

The American plant migration: Berthold Laufer, Field Museum of Natural History.

The criteria for a general, ancient Algonkin culture: Alanson Skinner, Milwaukee Public Museum.

The Ridatsa Indian: Care and training of the dog and horse: Gilbert L. Wilson, Macalester College.

The preservation of Indian remains in Wisconsin: Chas. E. Brown, Sec., Wisconsin Archeological Society.

The following papers were read by title:

Geographical influences upon human culture with special reference to the Great Plains: Melvin R. Gilmore, State Historical Society of North Dakota.

The technique of paleopathology as applied to human remains: Roy L. Moodie, University of Illinois, College of Medicine.

Aboriginal population in California: A. L. Kroeber, University of California.

Some vital aspects of the American Indian: Frederick L. Hoffman, Prudential Life Insurance Company.

Waning stone age industries among the Wisconsin Indians: Alanson Skinner, Milwaukee Public Museum.

Current illogical extravagant estimates concerning the antiquity of man: G. Frederic Wright, Oberlin College.

The afternoon session of December 29 was devoted to a conference on State Archeological Surveys.

On the afternoon of December 30, the section visited the Field Museum of Natural History to inspect the anthropological exhibits and afterwards visited the Newberry Library for an examination of the Ayer collection of Americana.

E. A. Hooton,
Secretary, Section H

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CONTENTS

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PARASITISM AS A FACTOR IN DISEASE[1]

THE study of etiology or causation is a study of the entire field of medicine from a certain point of view. Every phenomenon assumes an etiological aspect whenever we study it not as an effect to be simply contemplated and described, but as a cause or necessary condition of something that is going to happen. Provided with the information that for certain events to take place certain necessary conditions must precede, we can take steps by controlling the necessary conditions to allow the event to occur or not. Modern medicine has made the concept of causation its own. On it is founded all rational progress in prophylaxis and therapy. First to comprehend the cause, then to intercept and suppress it and thereby to prevent the next step is the kernel of medical science and practise. We project ourselves into the immediate future. The present is only the boundary between what has occurred and what is to happen. To control events we must know how to distinguish those conditions which are necessary from those which are merely associated and coincident.

The history of medical science, notably during the past half century, has clearly shown that observation of disease as it occurs in everyday life must be associated with the experiment. By observation I mean a survey or study of the phenomenon as a whole; by experiment, the observation of isolated parts of the entire phenomenon, the other parts being meanwhile eliminated or controlled by special devices. Observation and experiment, alternating, cooperating, and reacting on each other, are the only sure guides to a rational interpretation of disease. Nature is continu-

[1] Paper read at the annual meeting of the Association of American Physicians, May 10, 1921, as part of a symposium on etiology or causation of infectious diseases.

ally experimenting and observation is simply taking notes in this great life experiment. Without it the laboratory experiment would lack reality, for it is simply a page torn out of the book of nature with the unknown factors controlled or eliminated. To get at the facts of disease it has been found necessary to bring experiments as close as possible to the natural phenomena without losing control of the details.

The necessary association of observation and experiment in interpreting the conditions determining disease may be illustrated by the familiar one of the noise and the flash of gunfire. At a distance we see the flash and then hear the explosion. We might infer that the flash was a cause of the explosion, since it always precedes it. As we approach the scene of operations the noise follows the flash more and more quickly and close by the two reach our senses almost simultaneously. We then are in doubt whether the flash is a cause or merely an accompanying phenomenon. Our static observation at a distance fails to inform us correctly. The experiment of approaching the firing compels us to revise our original notion of causation and to make a further study of the entire phenomenon. The gist of the etiological problem is thus to determine what are necessary conditions and what merely secondary phenomena. The experimental method has been of immense service in laying bare the dynamic or causal relation, in other words, the true sequence of events. On the other hand, experiment too far removed from the actualities has frequently led astray when its results were too literally accepted and not controlled by observation of the entire phenomenon.

In the environment of man and within the human mechanism itself there are many conditions operative towards disease. This entire group or sequence of conditions, rather than any single factor in the group or sequence, may be regarded as the cause. If any one of these conditions is neutralized or controlled, the disease may not occur or if in progress it may take another course. Naturally these conditions have different values. They may be judged from their accessibility to control, *i.e.*, from a practical standpoint, or from the point of view of the physicist weighing them according to their energy values. We have hardly reached the stage, however, when the conditions favoring disease can be accurately measured. We must still deal with them as entities. Their qualities must engross our attention and their quantitative relations remain for a future, more exact medical science to weigh and measure.

The forces and conditions controlling disease are a mixture of heredity, environment, and parasitism. How can these factors be taken from their natural relations and studied individually without upsetting the delicate balances of causation? Where can we begin to test experimentally the observations we make about natural occurrences? Obviously some very careful surgical operation is necessary in carving out our field of work. In so doing we must realize that we become piece workers tinkering with only a part of nature's mechanism. Our finished product must be skillfully fitted into the larger mechanism. In attempting to limit our discussion to parasitism as an etiological factor in disease, I realize the difficulties mentioned. We have not only the different categories of environment, heredity and parasitism acting on one another, but within each category we have the animal body reacting with the factors like a chemical process swinging back and forth towards a state of equilibrium. Finally, we have in parasitism two living variable organisms capable of adjusting themselves towards each other in a remarkable degree.

When, about forty years ago, methods were devised by Robert Koch to make a beginning in the accurate study of bacteria as living agents of disease the contemporary scientific world realized that here were, to all appearances, agencies that could be separated from their environment, their life history and activities subjected to rigid investigation, and their relation to disease opened to demonstration. It is not surprising, therefore, that the bacteriologists of somewhat more than a generation ago, started on their way by these

methods, were inclined to regard the discovery of the pathogenic agent of some well-known disease as the beginning of the end of its prevalence. To have isolated, recognized, and cultivated a bacterium and produced some sort of pathological changes in an inoculated animal was considered equivalent to half or more of the battle won over the depredations of such organism. For many years these living agents, but more particularly the unicellular organisms among them, overshadowed all else and they became synonymous with the causes of disease. To-day we know that to have identified the microbic agent of any pathological process is but the beginning of the solution of the immediate problem and that it answers but one of a long series of questions. In spite of this somewhat discouraging fact, a very remarkable series of discoveries in the biology of disease have originated in this study of microorganisms. I need mention only the bringing to light of bacterial toxins, the discovery of their anti-toxins, hypersensitiveness or anaphylaxis, the phenomenon of acquired immunity and the collateral phenomena associated with it, such as the production of agglutinins, precipitins, complement-fixing bodies, and above all the specificity associated with the action of disease agents and the reaction of the host. Every one of these fundamental discoveries has had a far-reaching influence on the immediate development of the medical sciences. Every one in its way has dominated the thoughts and activities of large groups of investigators and there has resulted a very unequal, even chaotic, development of our knowledge of the conditions governing disease processes. Throughout this period dominated in turn by disinfectants, toxins, antitoxins, agglutinins, opsonins, complement fixation, and hypersensitiveness, there is evident some system, some purpose, and that is to find the exact place of living agents in the phenomenon of disease. From the more or less exaggerated point of view held at the start of their dynamic energy in the process there has been a more accurate, more scientific conception of their place as necessary conditions of disease making headway.

It is now evident that the relation of living agents, from the ultramicroscopic forms up to the higher parasites, is different for every agent or at least for every group of biologically related agents. We know now that the depth and extent of their etiological significance varies from an almost exclusive causation to one of relatively insignificant proportions. For the latter group the environmental and hereditary conditions completely dominate the situation and the particular germ found in one place may be replaced by others in another place. In most disease processes, therefore, the living agents are more or less governed by other factors. This is indicated by the great variation in the intensity of specific infectious diseases, by their seasonal appearance, by the sudden appearance and disappearance of outbreaks, and the difficulty of maintaining an epizootic among animals experimentally. Again, it is indicated by the difficulty of inducing disease with pure cultures in species of animals in which the disease occurs spontaneously and in the decline of virulence in artificial cultures.

Now it may be answered that when we fail to induce disease we do not know how to introduce the agent and where to deposit it. But the how and where are in themselves limitations of the activities of the specific agent. It may also be answered that the microbe with which we try to induce the disease has been attenuated by culture. True, the microbe needs the host to maintain its virulence. This is a significant limitation. Any one who has been confronted with a disease of unknown etiology and has in due time found the living agent knows how little or how much this means when he tries to construct the mechanism of the disease with its aid. In many cases the mystery remains as deep as ever until other necessary conditions have been isolated from the complex of causation.

Perhaps one of the most promising movements to bring into correlation with parasitism the other necessary conditions of disease is the study of epidemiology not from a statistical but from a biological viewpoint. To observe that of a given number of exposed

animals only a certain per cent. contract the disease and only under certain conditions inevitably leads to an inquiry into the causes other than the mere presence of infectious agents.

At this point it might be well to call attention to the necessity for including all invasive living agents however diverse in a study of the factors leading to disease and recovery. In pathology it has been customary to distinguish between parasitic invasion and bacterial infection, the former producing relatively slight disturbances in the host, the latter the acute, often highly fatal epidemic and epizootic diseases. The distinction is useful but it can be made to apply only to extremes. Gradations of all shades occur. For the sake of a more exact terminology, the distinction between invasion and infection might be made to hinge upon the capacity of parasites to multiply in the host. Thus the number of nematodes and related worms in the host is not larger than the number of fertile eggs introduced or of those individuals which actively penetrate as larvæ.[2] The formidable power of the infectious agents is due to their capacity for indefinite multiplication in the host. Sexual reproductive stages are not known. Certain protozoa such as sporozoa not only pass through sexual stages, but they may also multiply asexually and more or less indefinitely in the host tissues. They may be considered both invasive and infective. It is thus best to class all living invasive organisms as parasites, subject more or less to the same host mechanisms of repression and destruction. At one end of the scale are the highly specialized forms, adapted to one host species or even one race. At the other end are types emerging from the predatory or saprophytic stage and acquiring parasitic habits.

Another concept which we as medical men should have clearly before us is that the phenomena which medical science is chiefly interested in, namely, those of disease, are merely epiphenomena in an evolving parasitism, by-products which tend to lessen and disappear as the parasitism approaches a biological balance or equilibrium. How rapidly this evolution may progress we have no means of knowing. We do know that among animals epizootics tend towards a lower level of mortality and morbidity. If we are actually studying by-products, it is obvious that to understand them we must first understand the main processes that give rise to the by-products and that disease is studied most successfully by studying the necessary conditions that give rise to it. If the by-products are in themselves necessary antecedents of other pathological conditions, they would of necessity be included in any study of causation.

A sufficient number of living agents of disease and of parasites has now been studied to permit a tentative classification into highly specialized parasites adapted to and dependent on a given host and those that are more or less predatory, awaiting adaptation provided their organization should permit it. The highly adapted microorganism which depends upon one host for its existence, as, for example, the still unknown smallpox organism, has through natural selection established between itself and its host a certain balance or equilibrium. This can be defined as a condition of both host and parasite which permits the latter to enter the body, multiply enough and escape so that the arrival of its progeny in another host is assured. On the basis of this relationship we may define four critical phases in the life cycle of the microbe: first, its entry into the body and through protecting tissues; second, its transportation to and multiplication in certain tissues; third, its escape from those tissues and from the host as a whole; and fourth, its transfer to another host. Each one of these phases is capable of subdivision into a larger or smaller number of sequences according to the special living agent involved. In the insect-borne diseases the insect acts as transfer agent and as introducer into the blood. The fourth and the first stage merge. In general the fourth stage, or stage

[2] We must except from this broad statement the nematodes of the genera filaria and trichinella since their progeny develops within the same host to the larval stage and stops there.

of transfer from one host to another, has been greatly modified by civilization. It is therefore necessary in any attempt to formulate the problems of etiology to take into consideration the primitive conditions under which the infectious diseases originally flourished and from which they have come down to us. We do not know whether they originated with man or earlier among his progenitors. But it is safe to take the ground that infectious diseases flourished among the earliest races and that they flourish to-day among savage and semicivilized peoples as they do among domesticated animals in our midst. That is to say the infectious agents developed in an environment in which transfer from host was direct, immediate, and easily brought about. Furthermore, the infusion of susceptible subjects, except during wars and migrations, was slight. These two conditions tended to counteract one another and to bring to an approximate perfection the parasitic habit of the invading organism.

It is this fourth stage of transfer that engaged the entire attention of the early bacteriologists. They created the era of isolation and disinfection by improving diagnostic methods and studying the modes of exit of infectious agents and their resistance in transit. It was tacitly hoped and expected in this great work that infectious diseases could be easily controlled and suppressed by destroying the agents in the environment of the sick. The science of one generation becomes the practise of the next. Disinfection, isolation and the widening of the danger space between the sick or infected and the well is the chief occupation of modern sanitation. The actual significance of this practise needs to be evaluated from time to time if only in the interests of economy of effort. While it is generally conceded that the movement of the agents of disease should be restrained as much as possible and while heroic efforts are being made to this effect by health officials, economic forces are driving people together and condensing populations and thereby largely neutralizing the efforts of sanitarians. If any value can be put on this work at present, it might be to the effect that it tends to keep individuals from getting an overdose of infection.

When we come to the first phase in the cycle, the entrance of the virus into the body and its penetration through the skin and mucous membranes, our knowledge is on the whole neither accurate nor abundant. While the fourth stage has been pretty thoroughly exploited, the first is hardly at all known in its details. Each well established infectious agent will have its own story to tell of this phase. In extenuation of the deficiencies of our exact knowledge it should be stated that the problem is a very difficult one. Microorganisms leave the body in armies, having multiplied to supply a progeny ample to cover losses in transit. On entering only single individuals or small groups are involved and unless their morphology is characteristic, like that of the sporozoa and the metazoan parasites, the entry is well beyond the ken of the observer. It can only be got at indirectly. The difficulties of this stage are well illustrated by the prolonged discussions concerning the entry of tubercle bacilli. Much has been done and written in the attempt to clarify this problem. The doctrine of the inhalation of dried bacilli in dust, the droplet infection of fresh sputum, and the theory of the alimentary origin of infection have had their day in court. Similarly the portal of entry of the virus of the eruptive diseases has been the subject of much study and discussion.

The penetration of living agents through the skin and mucous membranes is full of unanswered questions. The resistance of the normal mucous coverings has probably been greatly underestimated. The effect of injuries in removing this barrier has been similarly underestimated. From a practical standpoint this problem may seem academic since the mucous coverings for example may rarely be free from minor lesions and such lesions may remain, at best, undetected. But the object of genuine medical science is to get away from the benumbing influence of such consideration. Do typhoid bacilli, for instance, penetrate the normal mucosa, or are they dependent on slight lesions? Do protozoa assist them

at certain seasons? Do phagocytes ever migrate out under normal conditions and carry bacilli back into the tissues? Might this take place when inflammatory processes are active? Is the entry of certain viruses prepared by other viruses acting only on the epithelium and destroying it or in some other way making the tissues involved more vulnerable? Epithelium-destroying parasites are well known among the sporozoa. It is not improbable that other types of microorganisms, especially those not within the range of the microscope, are specifically adapted as genuine parasites to invade these cells and so prepare the way for the saprophytic, predatory types which are readily recognized because easily cultured and therefore regarded as summing up the entire etiology.

After the living agencies have entered the tissues they must run the gauntlet of the blood, lymph, and the phagocytic cellular elements to reach those tissues where they multiply. Multiplication is essential, for a large progeny is necessary to cover the losses in transit. This stage of multiplication involves the problem of specific resistance or immunity and susceptibility, and also the practical problem of treatment by therapeutic agents, serums, vaccines, and the like. The biological requisite to be fulfilled by the parasite in this second stage, or stage of multiplication and sexual development within the host, if such a stage exists, is that multiplication must take place in such a way that escape in large numbers from the host after the parasites have assumed a more or less resistant form becomes possible. This is best accomplished when they settle down and multiply near some portal of exit, first the skin or subcutis, second the respiratory tract, third the digestive, and fourth the genital tract. A brief consideration of the localization of the different groups of parasitic agents will show that these various superficially located tissues are the chief seats of multiplication. Localization in other tissues or organs is rare and so far as the parasite is concerned abnormal. If it should happen that a race of *Treponema pallidum* arose which promptly and exclusively localized in the central nervous system, it would die out for want of an exit to another host. The tendency to locate and multiply in tissues of lower vital dignity, *i.e.*, near the surface of the body or the mucous membranes, safeguards the host as well as the parasite.

Among the parasitic invaders of man and the higher animals the metazoan and protozoan parasites have developed relatively perfect, in some cases complicated cycles. The same is probably true of those highly specialized microorganisms which produce the eruptive diseases and of some of the so-called filterable viruses. In fact, all diseases or parasitic states which maintain themselves indefinitely in a host species and are manifestly transmitted from case to case have complete, even though not necessarily elaborate cycles.

The tubercle bacillus is frequently referred to as a highly adapted parasite, but its parasitism is crude compared with that of the smallpox organism. It has no well-defined cycle except in phthisis, in which it is inhalation and expectoration. If for the sake of illustration we conceive the primary lesion as leading in every case to a secondary miliary tuberculosis in which there is extensive invasion of the skin with subsequent ulceration, the tubercle bacillus would then be inhaled and after multiplication shed from the skin, in so far approaching the smallpox organism in its cycle. But there is no indication that such a complete cycle ever will be established. On the other hand, the leprosy bacillus appears to have in a bungling way reached this stage, for the shedding of leprosy bacilli takes place from skin and mucous membranes, notably, of the nasal passages.

In certain cases the cycle is limited to a mucous membrane parasitism and the disease is the result of a diversion of the organism into the tissues of the body. The cycle of the typhoid bacillus may be some locus of the digestive tract with incursions into the blood. Whether the invaders perpetuate themselves, *i.e.*, escape again, depends upon ulceration of the lymphoid tissue of the intestines. The meningococcus resides in the upper respiratory tract. We do not know whether the cocci

which enter the central nervous system escape or not. This is an important question for it is probable that the degree of virulence of the microbe depends upon some contact with the host tissues more intimate than that of a mere saprophytic existence in recesses of the mucous membranes. If such an organism could associate itself with some living or dead factor which assisted its entrance and exit, a definite disease might thereby become established, and we might expect the disease to rise and fall in epidemic style according as the helping factor is active or not. Contact with and multiplication in living tissues, either cellular or humoral, appears furthermore to stabilize the microorganism. If we look over the immunological and serological data which have accumulated about the various groups of parasitic agents we find the relationships established by these reactions much more uniform among strictly invasive than among the secondary organisms which depend upon formidable factors to open the way into the system for them. Or to put it another way, there is a much larger number of serological types among the hangers-on than among those capable of direct invasion.

If the picture I have drawn of the parasitic cycle is fairly accurate, it follows that the localization of disease agents or parasites in all tissues and organs except those from which ready escape to the exterior is possible is abnormal and unnecessary for the continued existence of the parasite. Hence, typical, characteristic, recurring infectious or parasitic diseases affecting the central nervous system, the ductless glands, the liver and kidneys, the muscular system and the joints do not occur excepting as secondary localizations of diseases involving the more external tissues. If such localization should occur regularly without some superficial localization as well, we must look for some source of infection belonging to another species in which the cycle is normal and from which a constant supply of parasites is available even though they fail to escape from the new host. The invasion of the human body by the bovine tubercle bacillus is a familiar case in point. In some infectious diseases several invasions of the same host may be necessary to bring the parasitic cycle to completion or, viewed from a medical standpoint, to bring the disease to the clinical level. In bovine tuberculosis, which can be studied anatomically and topographically by killing animals in early stages, the first tubercle bacilli to enter the system usually land directly in regional lymph nodes. To complete the cycle the virus must enter the blood and establish secondary foci in lungs or other tissues from which the bacilli may escape to another host. The cycle is, however, more easily explained by reinfection. The inhaled bacilli lodge now in the lung tissue due to a changed reaction of the host tissues at the point of entry and the cycle—inhalation and expectoration, assisted by discharge in the feces through swallowing the sputum—is established.

There are two factors that may modify the normal cycles more or less. One is a relative immunity, which may be either natural or acquired. Through immunity cycles may be cut short chiefly in the stage of multiplication and the parasite fail to escape at all or in sufficient numbers to maintain further existence. If for any reason the normal resistance of the host is reduced, the parasite may multiply unduly or invade more territory and cause death of the host before the cycle is completed. This condition may be explained by regarding parasitism not as a condition of peace but of armed truce. As soon as one of the two organisms falls below a certain level, the other takes the advantage. In case the microorganism gets the advantage, it may be fatal for both host and parasite. This latter condition of reduced natural resistance is supplied by civilization either by bringing into the original disease other parasites and greatly complicating what might have been a simple situation, or else by conditions arising from inherited defects, over-exertion, abnormal diet, exposures to heat, cold, which are supposed to favor the parasite in its entry and multiplication. These conditions furnish the many modifications of disease types which may be as varied as the number of individuals at-

tacked. It is this increasing complexity of affairs which supports from the scientific side the dictum that the physician is to treat the patient rather than the disease for there is no longer a type disease to be recognized regularly.

This brings us back to the original subject of etiology. A careful biological study of the many parasitisms of man and the higher animals brings out the fact that the highly specialized parasites have no obstacles to their activity, except one and that is immunity, either acquired or natural. As a result all host individuals pass through the disease early in life provided opportunity for invasion is given. The highly specialized diseases tend to become, in endemic localities, children's diseases.

In the case of many other diseases certain non-parasitic factors are necessary to start the disease or to check it, as the case may be. They are part of the mechanism of causation and represent necessary conditions. These necessary conditions may far outweigh the living agents in etiological significance. The relative importance of the living factors may be so low that their place may be taken by other living agents or even non-parasitic factors in the sequence leading to or continuing existing disease processes. This is probably true of certain diseases of intestinal origin. Such diseases are frequently described as due to different microbic agents in different localities because the endemic flora happens to be different.

The relation between the factors of parasitism on the one hand and those of heredity, environment and the like on the other may be briefly summarized as follows:

In the saprophytic or predatory type representing the so-called septic infections the other parasitic and non-parasitic factors are of great, even predominating importance in the production of disease.

In the highly parasitic type they are of little, if any, importance unless it be hereditary characters brought out by the selective action of the parasites themselves upon the host species through many generations. Many gradations exist between these extremes and the relation of parasitic to extra-parasitic factors is different for the different grades.

Moving parallel with the degree of adaptation and specialization and the development of more nearly perfect cycles by the parasites the mortality drops and the morbidity at first spreads and finally tends to decline in certain types of parasitism, provided always that other types of parasitism do not accidentally enter to modify and complicate the normal course.

In tracing the various living agents through the body of the host we find that we do not know the details of any parasitism to our satisfaction. These details, of course, include also the non-parasitic factors or conditions essentially favoring or hindering the parasite in its sojourn in and its journey through the host tissues. It is perhaps needless to refer at length to the conditions which control the acquisition of such knowledge. The hope of finding some preventive or cure dictates the course of many workers. When something approaching this has been found the etiological significance of all the other factors bearing on the disease falls below the horizon for the time being. The importance of continuing the study of the disease persists however even for practical reasons, for the remedy or preventive may not prove to have the success anticipated. To induce men to fill the gaps of our knowledge seems quite as important as the pioneering for entirely new vistas or outlooks. Great discoveries are, as a rule, half-truths that must be brought into line by patient after-research. The filling of gaps may be necessary to stage the next great discovery.

There is beyond the mere knowledge that gaps exist the difficulties of the problems involved to be considered. Are we prepared to solve them directly or must we rely on indirect approaches and on the solution of analogous problems to satisfy our etiological sense? Added to these difficulties inherent in some phases of the parasitic cycle, notably that phase which takes place within the host, is the fact that the various disease agents attacking the same species, man for instance, are so different from one another that we may safely

consider them surviving types. It would seem that where two or more parasites follow the same route and multiply in the same tissues a certain competition tends to eliminate one or the other. If two closely related types exist they rarely multiply in the same host at the same time. Such competitive elimination would leave a divergent assortment of parasitic organisms and resulting diseases, none of which would be an exact copy of the other. In this case the working out of one cycle does not necessarily enable us to predict what another would be. They must each and all be studied individually.

In this dilemma we may gain assistance from a study of parasitisms in those remote and isolated regions which have not yet been seeded by the white man's diseases, where the prevailing maladies may still be "pure lines," rather than mixtures and combinations. Another source of material are the many characteristic parasitisms of animal life, notably of the mammals and birds. Comparative pathology may furnish us with that information which experimental pathology finds it impossible to produce. Taking all the diseased and abnormal states due to living agents in man and the higher animals together, a series may be established which fills in many gaps and which may furnish the suggestions and clues needed to bring about a better insight into the dynamic relations between host and parasite. Only through the cooperation of comparative and experimental methods may we hope to gain enough general underlying concepts to explore with some show of rationality new diseases successfully. Since science is valued in proportion to its capacity to predict successfully certain events, medical science will be judged by the way it takes hold of a new phenomenon to determine its etiological antecedence. If, in the course of its development, it has failed to take cognizance of factors necessary to build the science into a consistent whole, it should retrace its steps and make up the deficiency.

Parallel with the continued analysis of phenomena there should be another process going on to simplfy the complexity resulting from the former and to bring the results of scientific inquiry more or less within the reach of everyday life. What is needed is a synthesis of the many data resulting from analytic study of phenomena. Perhaps I can make myself clearer by using as an illustration some recent investigations. If we examine the various diseases in which the virus is conveyed by insects and arachnids, we shall find that many of the data pertaining to the dissemination of the virus had been accurately worked out before the mode of transmission was discovered. There was lacking, however, a something to harmonize and coordinate them. When the insect carrier was defined these various discrete, apparently unrelated data fell into line. Here was a synthesis which not only substantiated older observations but it enabled the scientist to use the deductive method to develop new inquiries and thereby lift the subject up to a higher level for further analysis. For some years we had known that a certain disease of young turkeys, due to the invasion of the tissues through the intestinal tract by a protozoan parasite, could be prevented by raising these birds away from older turkeys and common poultry and on soil uncontaminated by them. The explanation came through the discovery that a common worm of these species was needed to injure the mucous membrane and thereby open the way for the protozoan parasite. The nematode also accounted for certain disturbances in the application of the above rules in the rearing of these birds. It synthesized, in other words, the accumulated data.

With the aid of these illustrations it is possible to understand, at least in part, what must have been the effect of the rapid discovery of various living agents in the eighties of the last century on the medical mind of the period. Many apparently unrelated data suddenly moved into line and assumed definite relations to one another. The discoveries pertaining to acquired resistance to disease involving the action of antitoxins, agglutinins, precipitins and the like have not had as yet the desired effect of synthesizing the conception of immunity, because they may be ac-

cessories rather than essential factors, all grouped around some more fundamental, unifying, still undefined phenomenon.

Theobald Smith
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THE FIRST APPEARANCE OF THE TRUE MASTODON IN AMERICA

I have recently published a paper[1] under this title, naming one species *Mastodon matthewi* from the Lower Pliocene of Snake Creek, Nebraska, and another species *Mastodon merriami* from what I supposed to be the Middle Pliocene of Nevada, in honor of Dr. William D. Matthew and Dr. John C. Merriam, respectively.

I have just learned from Dr. Merriam that *Mastodon merriami* is not, as I supposed, of Pliocene but of Middle Miocene age, which makes this species all the more important and interesting as the first to reach America. Dr. Merriam writes, June 24, 1921:

> The locality described by Mr. Hills, namely, that at which G. D. Matheson secured his material, is, however, in the Virgin Valley formation, which is of approximately middle Miocene age, not far from the zone of the Mascall of the John Day region. The opal mines are in the Virgin Valley formation and lie between the two main forks which unite to form Thousand Creek. These streams are Virgin Creek and Beek Creek. They unite on the west side of the great Rhyolite mass which separates the lower part of the Virgin Valley beds from the areas of the Thousand Creek formation lying to the east. The change in the age of *Mastodon merriami* suggested by the data given above will, I am sure, interest you greatly as this evidently brings the appearance of these Mastodons back to near middle Miocene.

I am greatly surprised and interested by the Middle Miocene appearance of the true mastodons in America, if the above report by Dr. Merriam is correct, as I have no doubt it is. Middle Miocene age is, in fact, quite consistent with the structure of the superior canine tusks, which bear a broad enamel band on a *concave* outer side, a fact that puzzled me greatly because Dr. Schlesinger describes the Lower Pliocene mastodons of Hungary as bearing an enamel band on a *convex* outer surface. We should expect the earlier mastodons to show just the difference in the curvature of their tusks which these two observations would indicate.

It now seems that the true mastodons may be traced back to the species *Palæomastodon beadnelli* Andrews, living along an ancient river corresponding to the Nile, in company with a primitive long-jawed proboscidean to which Andrews and Beadnell gave the name *Phiomia serridens* in 1902. This was in Upper Eocene or Lower Oligocene times. In Lower Miocene times the true mastodons appear in North Africa and reappear in the Middle Miocene of France, although far less abundant than the contemporary species of long-jawed animals named *Mastodon angustidens* by Cuvier, which are descended from *Phiomia*. The rarity of the true mastodons is attributable to their strictly forest-living habits. They occur rarely in the Miocene and Lower Pliocene of France and Switzerland, also in Austria as recently described by Schlesinger of Vienna.

If the *Mastodon merriami* of Nevada proves to be of Middle Miocene age, it will demonstrate that these true mastodons came to this country much earlier than we have been led to suppose. The earliest arrivals hitherto recorded in this country are the *Mastodon brevidens* and *M. proavus* of Cope, which hailed respectively from the Middle Miocene of Oregon and of Colorado. It is not yet positively known whether these two species are true mastodons or representatives of one of the other phyla.

Henry Fairfield Osborn
American Museum of Natural History,
June 29, 1921

[1] *Amer. Mus. Novitates*, No. 10, June 15, 1921.

SCIENTIFIC EVENTS

THE SCIENCE CLUB OF THE UNIVERSITY OF MISSISSIPPI

During the academic year 1920–21, the Science Club of the University of Mississippi,

composed of members of the science faculties, held seven meetings. The following papers were presented:

Oct. 1920. Tabulated results of questionnaire circulated among students the previous year to ascertain student attitude toward marriage, by H. R. Hunt, Ph.D.

Nov. 1920. Some phases of American archæology (lantern demonstration), by Calvin S. Brown, Sc.D.

Dec. 1920. Intestinal intoxication as a bacteriological problem, by Paul R. Cannon, Ph.D.

Jan. 1921. Tabulated results of physical examination of students, with discussion, by Byron L. Robinson, M.D.

Feb. 1921. Petroleum, with particular reference to its presence in Mississippi (specimens demonstrated), by J. N. Swan, Ph.D.

Mar. 1921. Influenza, case citations and brief review of literature, by Whitman Rowland, M.D.

April 1921. Malaria, its incidence and control, by W. S. Leathers, M.D.

Throughout the past year the club has extended the privilege of its meetings to advanced students, and with very gratifying results.

C. F. De Garis,
Secretary

THE WORK OF THE ROCKEFELLER FOUNDATION

A review of the work of the Rockefeller Foundation, issued by the president, Dr. George E. Vincent, summarizes as follows the activities of the Rockefeller Foundation, the International Health Board, the China Medical Board and the Division of Medical Education:

Aided six medical schools in Canada.

Gave a large sum to a medical training center in London.

Appropriated 1,000,000 francs for the Queen Elisabeth Foundation for Medical Research in Belgium.

Agreed to contribute toward the complete rebuilding of the medical school of the University of Brussels.

Provided American medical journals and laboratory supplies for ten medical schools and medical libraries in five European countries.

Continued to construct and maintain in Peking, China, a modern medical school with a pre-medical department.

Aided thirty-one hospitals in China to increase their efficiency in the care of patients and in the further training of doctors and nurses.

Supported the School of Hygiene and Public Health of the Johns Hopkins University.

Contributed to the teaching of hygiene in the medical school at Sao Paulo, Brazil.

Provided fellowships in public health and medical education for ninety-three individuals who represented thirteen different countries.

Brought to the United States commissions of medical teachers and hygienists from England, Belgium and Czechoslovakia.

Continued to support a campaign against yellow fever in South and Central America and in West Africa.

Aided Government agencies in the control of malaria in ten states of the South.

Prosecuted hookworm work in ten southern states and in eighteen foreign countries.

Helped to expand anti-hookworm campaigns into more general health organizations in countries, states and nations.

Brought a wartime anti-tuberculosis work in France to the point where it could soon be left entirely in French hands.

Assisted the Government of Czechoslovakia to reorganize its public health laboratory system.

Rendered various services in organizing committees to study the training of nurses and of hospital superintendents, lent experts for conference and counsel, sent officers abroad to study conditions, etc.

Brought to a close its participation in wartime emergency relief by giving $1,000,000 to the fund for European children.

THE EXPOSITION OF CHEMICAL INDUSTRIES

As has already been noted in Science, the Seventh National Exposition of Chemical Industries will be held at the Eighth Coast Artillery Armory, New York City, during the week of September 12. According to an announcement issued by the directors, the growth of the Chemical Exposition during the last seven years has been a barometer of the trend of public thought and interest in America's scientific achievements. Manufacturers, engineers, scientific men and students are drawn toward these remarkable displays from all corners of the country. It has therefore be-

come necessary to stage the 400 exhibits of this year's event in an exposition building of immense proportions, covering an area of five city blocks. As much of the program is carried out in speeches, lectures, and papers of value to the investigator along these lines, a special auditorium arranged according to the plan of a theater, and having a seating capacity equal to many such houses, will meet the needs of a quiet and comfortable lecture hall. It will offer an ideal place for the many symposiums that will be held during the week.

These will take the nature of scientific discussions, practical talks, exchange of ideas, "get together" meetings, and motion pictures covering every industry, lent through the courtesy of the government, numerous companies and plants where these industrial reels have been filmed.

Dr. Charles H. Herty, editor of the *Journal of Industrial and Engineering Chemistry,* is chairman of the advisory committee. Others on this board include Raymond F. Bacon, director, Mellon Institute; L. H. Baekeland, hon. professor chemical engineering, Columbia University; Henry B. Faber, consulting chemist; John F. Teeple, president, the Chemists Club; Bernard C. Hesse, chemist, General Chemical Co.; Acheson Smith, president, American Electrochemical Society; A. D. Little, president, Arthur D. Little, Inc.; William H. Nichols, chairman of the board, General Chemical Co.; H. C. Parmelee, editor, *Chemical and Metallurgical Engineering;* Fred W. Payne, co-manager of the exposition; R. P. Perry, vice-president, The Barrett Co.; Charles F. Roth, co-manager of the exposition; Edgar F. Smith, president, American Chemical Society; T. B. Wagner, vice-president, U. S. Food Products Corporation; David Wesson, president, American Institute of Chemical Engineers; and M. C. Whitaker, president, United States Industrial Chemical Company. The headquarters of the exposition are now located at 342 Madison Avenue, New York City.

THE CHEMICAL MEETING IN NEW YORK CITY

Governor Miller will go on Labor Day to Niagara Falls to welcome officially the delegates of the British Society of Chemical Industry, who will visit the United States to hold a joint meeting with the American Chemical Society. At the head of the overseas delegation will be Sir William J. Pope, president of the Society of Chemical Industry. Among other prominent members will be Dr. Louis A. Jordan, who was sent to aid the Italian government in the making of explosives; Dr. Frederick William Atack, whose principal work has been the chemistry of dyes; Dr. Andrew McWilliams, one of the best known steel metallurgists in Great Britain; and Dr. Andrew Smith, an explosives engineer of international reputation. Some of the eminent Canadian chemists will be: Dr. R. F. Ruttan, past president of the Canadian Section of the society; Dr. Milton L. Hersey, one of the founders and past chairman of the Canadian Section; and Dr. C. R. Hazen, chairman of the Montreal Section.

According to the preliminary program of the American Chemical Society, made public today, registration begins at the Chemists Club, 52 East 41st Street, on Tuesday, September 6. The dinner of the Council will also be held at the club. The general meeting will convene at 10 o'clock on the following day at Columbia University, and at half past twelve o'clock the Society of Chemical Industry's luncheon to British and Canadian visitors will take place. There will be a reception and lawn party for the members of all societies concerned, to be held on the Campus of Columbia University, and in the evening a smoker will be held in the Waldorf-Astoria.

A joint meeting of the American Chemical Society and of the Society of Chemical Industry of Great Britain has been arranged for four o'clock on Thursday afternoon and in the evening will be held a banquet at the Waldorf-Astoria. The various divisional and sectional meetings are scheduled at Columbia University. The sessions will conclude with a public meeting, at which the president, Dr. Edgar F. Smith, will deliver the annual address. The last day will be given to excursions to various chemical plants and other points of interest in the city.

SCIENTIFIC NOTES AND NEWS

Sir Joseph Thomson has been elected honorary professor of natural philosophy and Sir Ernest Rutherford professor of natural philosophy at the Royal Institution.

The Osiris prize of 100,000 francs has been awarded by the Academies of the Institute of France to General Ferrié, director-general of French military telegraphs, in recognition of his work in the development of wireless telegraphy for war purposes.

We learn from *Nature* that at the annual visit to the National Physical Laboratory of the members of the General Board on June 28 a bas-relief in bronze of the former director, Sir Richard Glazebrook, was presented to the laboratory. The presentation was made by Sir Joseph Thomson and received on behalf of the laboratory by Professor Sherrington, president of the Royal Society.

Dr. Michael E. Gardner has been appointed chief of the bureau of preventable diseases and director of the bacteriologic laboratory of the United States Public Health Service.

Dr. J. H. Shrader, formerly of the United States Department of Agriculture, has been appointed director of the Bureau of Chemistry and Food, Health Department, Baltimore, Md.

Charles Y. Clayton, professor of metallurgy at the Missouri School of Mines, is working at the laboratory of Dr. H. M. Howe at Bedford Hills, N. Y., during the summer.

Olaf P. Jenkins, associate professor of economic geology at the State College of Washington, is in charge of the field work for the Washington Geological Survey and is investigating certain road materials, the Grand Coulee as a reservoir site, and the iron ores of Washington in relation to the possible manufacture of iron and steel.

Harlan I. Smith, of the Victoria Memorial Museum, Ottawa, Canada, is now in the field carrying on the investigations of the ethnology of the Bellacoola Indians of British Columbia which were begun by him in 1920 under the auspices of the Geological Survey of Canada.

The annual meeting of the French Association for the Advancement of Science is being held this year at Rouen from August 1 to 6.

The Municipal Observatory at Des Moines, Iowa, which is said to be the only municipal observatory in the world, was opened on August 1. The observatory building is to be equipped by Drake University with an 8-inch equatorial telescope. It is to be under the control of the university and open to the public at least three times a week, and at any other time when occasion may warrant.

A new forest experiment station, the first in the Eastern States, has been established at Asheville, N. C., by the Forest Service of the United States Department of Agriculture. Steady depletion of the Southern Appalachian timber supply has been responsible for the location of this station in the East, and the object of the work to be conducted will be to secure the information needed by foresters to determine the best methods of handling forest lands in the southern mountains.

The Swedish Academy of Sciences has asked the government to set aside a million and a half kroner from the private funds of the Nobel Foundation and apply the interest to the Nobel prizes as owing to the depreciation of the Swedish krona the recipients of the prize do not receive the former value.

The French Academy of Medicine has received a donation from the widow of the Marquis Visconti to found a triennial prize of 3,000 francs in memory of Infroit, the radiologist.

The school of mines of the College of Engineering of the University of Alabama offers five fellowships of the value of $540 in mining and metallurgical research in cooperative work with the U. S. Bureau of Mines. They have been established for the purpose of undertaking the solution of problems being studied by the U. S. Bureau of Mines that are of especial importance to the State of Alabama and the Southern States.

The members of the American Chemical Society were informed of the printers' strike and the action of the council regarding it in the May issue of the *Journal of Industrial and*

Engineering Chemistry. The secretary writes: "The May *Journal,* the May and June *Industrial Journal,* and the May 10 *Abstracts* have been mailed to members. The June *Journal* and May 20 *Abstracts* are about to be mailed. The July *Industrial Journal* will follow soon. Our publishers report that they now have a full corps of men, although somewhat inexperienced in chemical printing. They state that as far as they are concerned the strike is over, and there will be no increased printing costs to the society, but that it will take them a few months to get back on the very prompt schedule that they have given us for many years past. Members are asked to be patient regarding the receipt of their journals with the assurance that in a few months everything will be normal again."

WE learn from the *British Medical Journal* that the expedition sent to British Guiana by the London School of Tropical Medicine to investigate filaria has been at work since the middle of April. It was dispatched at the request of the then Secretary for the Colonies, Lord Milner, who considered that further information was required as to the best method of controlling filariasis. The leader of the expedition is Professor R. T. Leiper, director of the helminthology department of the London School of Tropical Medicine; he was accompanied by Dr. John Anderson, Dr. Chung Un Lee, and Dr. Mahomed Khalil of the Egyptian Medical Service; Dr. G. M. Vevers, demonstrator of helminthology in the London School of Tropical Medicine, will leave England to join the expedition very shortly. It was originally arranged that the expedition should last for six months, and at the suggestion of Sir Patrick Manson it is proposed that visits shall be paid to certain West Indian islands, choosing one, such as Barbados, where the rate of attack is high, and another, such as Grenada, where it is low. It is hoped that by comparing and contrasting the circumstances of two such islands light may be thrown on the conditions which favor the filaria.

THE New York State Association of Consulting Psychologists has been established. The purposes of the organization are: "The promotion of high standards of professional qualifications for consulting psychologists" and "Stimulating research work in the field of psychological analysis and evaluation." Membership is limited to those who have the minimum requirements of two years graduate work in psychology. The Executive Committee for the current year are: David Mitchell, President; Louis A. Pechstein, vice-president; Elizabeth A. Walsh, secretary-treasurer; Elizabeth E. Farrell, Samuel B. Heckman; Leta S. Hollingworth; Robert S. Woodworth. The association has already begun active work and is making psychological examinations of children, and the Department of Education plans to organize classes on the basis of the results secured through the psychological examinations.

THE committee appointed to judge the scientific exhibit at the Boston meeting of the American Medical Association, which consisted of Dr. W. B. Cannon and Dr. G. W. McCoy, has awarded a gold medal to Dr. Kenneth M. Lynch of the department of pathology of the Medical College of the State of South Carolina, for his exhibit of photographs and microscopic preparations illustrating investigation of ulcerative granulomata. Certificates of merit are awarded to Dr. V. H. Kazanjian of the Harvard Dental School for his exhibit of plaster masks, casts and photographs of war injuries to the face and jaws, and Drs. Mendel, Osborne and Bailey of the Connecticut Agricultural Experiment Station for their exhibit illustrating the effect of different qualities of protein upon growth.

DR. LYNDS JONES, of the department of ecology of Oberlin College, is in charge of a scientific expedition into the northwestern part of the United States. Five men and eleven women research students will make a tour in specially prepared Ford cars, with complete camping outfit. Starting at Grinnell, Iowa, the party will visit Lake Okoboji, and will then go through Minnesota along the old Yellowstone Trail. Special stops will be made at Aberdeen, South Dakota, and Billings, Montana. After visiting the Glacier National Park a sixteen day trip will be made into Alaska.

UNIVERSITY AND EDUCATIONAL NEWS

DR. K. G. MATHESON, president of the Georgia School of Technology, announces that the sum of $1,222,857 has been contributed toward the fund of $5,000,000 which the institution has undertaken to raise for permanent buildings and equipment.

DR. WADE H. FROST, former surgeon in the United States Public Health Service, has been appointed head of the department of epidemiology and public health administration in the School of Hygiene and Public Health of the Johns Hopkins University.

LIEUTENANT-COLONEL HARDEE CHAMBLISS, since 1919 commanding officer of the U. S. nitrate plant at Sheffield, Ala., has been appointed to take charge of the work of the department of chemistry at the Catholic University owing to the prolonged illness of the Reverend Dr. John J. Griffin, who has been in charge of the department since its opening in 1895.

DR. ROBERT H. LOWIE is leaving the American Museum of Natural History, where he has been associate curator in the department of anthropology, to accept the position of associate professor of anthropology at the University of California.

DR. BERTRAM G. SMITH, of the Michigan State Normal College, has been appointed associate professor of anatomy, in charge of embryology and histology, in the New York University and Bellevue Hospital Medical College.

DR. CHESTER A. MATHEWSON, for seven years head of the department of science in the Maxwell Training School for Teachers, Brooklyn, N. Y., has been appointed head of the department of biology in the School of Education at Cleveland, Ohio.

IN the Oregon Agricultural College, H. H. Gibson, professor of vocational agriculture in the University of Arizona, has accepted the headship of the department of agricultural education. He was formerly director of agricultural education in the University of Vermont. John R. Du Priest, professor of steam and gas engineering and design in the Rensselaer Polytechnic Institute, Troy, N. Y., has been appointed assistant professor of mechanical engineering.

DISCUSSION AND CORRESPONDENCE

A DEFENSE OF PROFESSOR NEWCOMB'S LOGIC

TO THE EDITOR OF SCIENCE: To those acquainted with Professor Simon Newcomb's mental habits and with Professor Comstock's usual preciseness of language, the latter's criticism of Newcomb's statement concerning ultra-mundane life is puzzling (SCIENCE, July 8, 1921). After several readings I venture the opinion that he appears to impugn the logic which he seems to think Newcomb might have used in coming to the conclusion that "to suppose" countless worlds are inhabited "is perfectly reasonable." Is there a chance that Professor Comstock may be the victim of his own false premise, contained in the sentence with which he starts upon this phase of the subject: "As to the numerous worlds alleged (*sic*) to be the abode of life, Newcomb in his essay . . . " says so and so. If we may trust the dictionaries, *to allege* is to make a positive assertion, or a statement which the alleger is under obligations to prove; whereas *to suppose* is to "conceive a state of things . . . , but not free from doubt" (*Century Dictionary*). So far as my search has gone, Newcomb has not at any time alleged or asserted the existence of animal life in other worlds; he has merely supposed, and said that such supposition "is perfectly reasonable." A reading of his admirable essay on the subject ("Life in the universe," in "Side-Lights on Astronomy," 1906) should, in my opinion, convince of the reasonableness.

W. W. CAMPBELL

MOUNT HAMILTON, CALIFORNIA,
July 16, 1921

BIOLOGICAL CONTROL OF DESTRUCTIVE INSECTS

TO THE EDITOR OF SCIENCE: Control of destructive insects by the introduction of their

natural enemies has become an important technique during the last generation. But if competent observers are to be trusted, the southern Arabs employed the same method more than 150 years ago, in the culture of the date-palm.

In his "Relation d'un Voyage dans l'Yemen" (Paris, 1880, p. 155), P.-E. Botta says:

> I was able to verify the singlar fact previously observed by Forskål, that the date-palms in Yemen are attacked by a species of ant which would cause them to perish, if each year the growers did not bring from the mountains and fasten in the tops of the palms branches of a tree that I did not recognize, which contain the nests of another species of ant which destroys that of the date-palm.

P. Forskål was the naturalist of C. Niebuhr's expedition; his work was published posthumously in 1775. I have not seen his account to which Botta refers.

It would be interesting to know whether the history of economic entomology furnishes any earlier record of the "biological method" of pest control.

Paul Popenoe

Thermal, Calif.,
April 24, 1921

A LONGLIVED WOODBORER

From its burrow in the top piece of an old birch book-case at Mt. Pleasant, Iowa, a soft white wood-boring grub was shaken recently, when the owner discovered the newly made opening and conical pile of wood chewings that had been thrust out. There is nothing unusual about finding grubs in wood, but this particular wood-boring larva has a strange history.

The matured larva was given to the writer and placed in a box to complete its development. It pupated in about two weeks and in a few days the adult beetle emerged. It was *Eburia quadrigeminate* Say, a longicorn commonly known as the honey-locust borer, and is recorded as developing in hickory, ash and honey locust.

Mrs. Doe, who owns the book-case, is certain that the board in which the grub fed and grew from egg to a matured larva is no less than forty years old, as the book-case has been in the possession of the Does for at least that many years.

Just how and why this creature should have spent so many years in this humdrum life between the narrow walls of a thoroughly seasoned birch board only five eighths of an inch thick, and never once coming out for air or water seems remarkable indeed.

Mr. J. McNeil, writing in the *American Naturalist*,[1] tells of two longicorns of this same species emerging from an ash door-sill that had been in place nineteen years. In that case the relation of the tunnels to the solid brick wall on which the door-sill rested seems to have made it certain that the eggs were laid in the wood before the house was built. This case seems to outstrip any known insect record in point of longevity.

H. E. Jaques

Iowa Wesleyan College,
Mt. Pleasant, Iowa

QUOTATIONS

THE COST OF PRINTING SCIENTIFIC WORKS IN ENGLAND

Officers of learned societies and librarians have made public a memorandum planned to impress on the printing and publishing firms of the United Kingdom the danger which they are incurring by enforcing the recent enormous increase in the price of books, more especially books of the more serious and specialized sort. They say:

> It is not only to the public detriment, but clearly also to the detriment of the printing and publishing trades, that learned societies should be forced to cut down or suspend altogether their output of proceedings and monographs, and that libraries should have to reduce to a minimum the number of books which they purchase. It is obvious that if books are bought in ever-decreasing numbers, publishers will find it useless to print anything, however valuable, which does not appeal to the unlearned public. And if societies are

[1] Vol. XX., p. 1055.

unable to continue their series of publications there will be less work for printers. More money can not be raised either by societies, whose members mainly come from those professional classes which the war has hit most hardly, or by libraries which depend on private funds drawn from those same classes.

We are aware that material costs more, and that printers' labor is now remunerated on a scale which has forced publishers to raise all prices. But the general economic conditions which led to these phenomena are beginning to change. The existing scale of book prices means the cessation of book-buying. Unless novels and school books are to be the only output of the future, the present state of things must come to an end. The remedy lies with the trade; the buying public has come to the end of its resources, and refuses to be exploited any longer.

To this statement Mr. Geoffrey S. Williams, president of the Publishers' Association of Great Britain and Ireland, makes reply in the *Times*, saying:

It is unfortunate that the signatories of the manifesto about the cost of printing should have included publishers in their indictment, for publishers are fellow-sufferers with the signatories. They are dependent on the printing, binding, and paper-making trades, and until the charges made by these trades are materially reduced it is quite impossible for publishers to issue books at lower prices. On the whole, prices of books have not advanced to anything like the extent that would have been justified by the increases in the costs of production.

It is not easy to quote figures, for books, like human beings, have distinct individualities, especially from the publisher's point of view; hardly any two of them are exactly alike, though they wear the same clothes; but from calculations that have recently been before me, and give, I believe, a very fair comparison of the prices ruling in 1914 and now, it appears that the cost of printing is approximately two and three-quarter times what it was in 1914, paper (of an inferior quality) costs over double what it did in 1914, binding (also of an inferior quality) costs rather more than three times what it did in 1914, while the total cost of a large edition of a small book works out at about 180 per cent. above the 1914 figure, and publishers' establishment charges and the cost of advertising have kept pace with other items in their upward course.

SPECIAL ARTICLES

A BACTERIAL DISEASE OF GLADIOLUS

AN undescribed bacterial disease of *Gladiolus* has been under observation in this laboratory for a number of years, and recently a more intensive study has been undertaken. The following brief description is offered as preliminary to the publication of the complete study.

The organism has been isolated repeatedly and its pathogenicity proved by inoculation of healthy plants. The parasite is briefly characterized as follows:

Bacterium marginatum n. sp.

A cylindrical rod varying considerably in length, $1–3.5 \times 0.5–0.8\,\mu$, frequently in pairs and forming chains in beef bouillon; motile by means of 1–2 polar flagella; aerobic, no spores, capsules present.

Superficial colonies in peptone-beef agar plates are very characteristic; circular, smooth, slightly elevated centers surrounded by a wide thin border more or less irregular at the margin. Width and character of the border vary slightly under different conditions. Growth is white and extremely viscid.

Liquefies gelatin; liquefies blood serum; does not reduce nitrates; produces slight acidity in milk; digests casein; produces acid in cultures with various sugars. Grows well in Cohn, Fermi and Uschinsky's solutions. Produces moderate amounts of indol and ammonia. No gas is formed.

Temperatures for growth, maximum 40° C., minimum 8–9° C., optimum 28–30° C. Thermal death point about 52° C. Does not grow at temperatures below 8° C., but remains alive for at least 8 weeks at 1–2° C.

Gram negative. Group number: 211.2222022.

Pathogenic in leaves of gladiolus forming circular to elliptical lesions rusty red in color becoming dull brown or purplish. These spots may occur on all parts of the foliage but are often confined to the lower leaves. Observation and experiment indicate that the disease makes rapid and dangerous progress only in warm and moist weather when the rot spreads

widely and deeply into the tissues, causing the collapse of the aerial part of the plant.

The disease caused by these bacteria is very prevalent in and about the District of Columbia. In the fields examined, 80–90 per cent. of the plants were affected but in the majority of these cases not so severely as to noticeably arrest the development and bloom of the plant.

Plants with the same disease have been received from Illinois with the information that it has caused loss to the growers. Some *Gladioli* from California apparently had the same disease but the case was not completely proved.

Lucia McCulloch,
Bureau of Plant Industry,
U. S. Department of Agriculture

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

SECTION OF SUGAR CHEMISTRY AND TECHNOLOGY

C. A. Browne, *chairman*
Frederick Bates, *secretary*

A rotary digester for use in bagasse analysis: G. L. Spencer. A rotary digester is described for the digestion and extraction of bagasse for purposes of analysis. 100 grams of chopped bagasse are weighed in a tared cylinder: 1 liter of hot water is added. If ammonia is used for preserving the bagasse, no alkali is added to the digestion water, otherwise sodium carbonate is added. The cylinders are closed and revolved in the digester for an hour while steam is turned into the casing. The steam is then shut off, cold water is admitted to the casing and the revolution continued until the sample is cooled. The cylinders are then removed, dried and weighed, the rest of the procedure being the same as in the customary methods of analysis.

Determination of reducing sugars in lead preserved cane juices: J. B. Harris. Samples of raw cane juices for purposes of factory control are composited and preserved with dry lead subacetate. In the determination of reducing sugars, the preserved juice gives results about 10 per cent. too low where sodium oxalate or other normal salts are used to delead. Experiments with various deleading agents show it to be necessary to change reaction of preserved juice to acid in order to recover the reducing sugars combined with the lead. Best results are obtained with oxalic acid as a deleading agent, as it always gives the same results on the preserved juice as are obtained on the same juice without the use of lead or any deleading agent.

Dry substances in molasses, syrups and juices by the Spencer electric oven: George P. Meade. The Spencer electric oven is an apparatus originally devised for rapidly drying granular and fibrous substances, such as sugar, bagasse, etc., by drawing a large amount of heated air through the material to be dried. On suggestion of the inventor, Dr. G. L. Spencer, a method has been worked out for liquid sugar products by absorbing the liquid on asbestos as in the Babcock method for drying milk. With a ten minute heating period, known solutions of sugar, and of invert sugar and salt, are dried quantitatively to one part in 300 or better. Thick solutions, such as molasses and honey, must be diluted with water, one to one by weight. Duplicate tests on many different kinds of molasses, and on honey and cane juice, show close agreement.

Two simple tests for the control of the crystallizer and centrifugal machine work: M. J. Proffitt.

A comparison of the results in the process of desugarization with the Steffen lime process, the barium process and the strontium process: M. Potvliet. The desugarization appears to be in favor of the barium process. The real purity of the juices after deduction for raffinose is highest in the barium process. No raffinose is eliminated either in the Steffen lime process or in the strontium process, whereas in the barium process approximately 50 per cent. of the raffinose is removed into the waste water. The removal of the raffinose is important in view of the discarding of molasses. Of the 48.5 per cent. real sugar in the worked molasses, there was obtained: in the lime process 35.45 per cent. as granulated, 8.05 per cent. in molasses and 5.00 per cent. in waste water; in the barium process 43.97 per cent. as granulated, 2.91 per cent. in molasses and 1.62 per cent. in waste water; in the strontium process 43.18 per cent. as granulated, 4.32 per cent. in molasses and 1.00 per cent. in waste water. The rather heavy waste water of the barium and strontium processes can easily be concentrated to 42° Bé, whereas the very diluted Steffen waste water with large amounts of soluble lime compounds causes many difficulties. Waste water with 42° Bé contains about 12 per cent. K_2O and 4 per cent. N.

The effect of varying hydrogen-ion concentration upon the decolorization of cane juice with carbon: J. F. BREWSTER and W. G. RAINES.

The effect of some decolorizing carbons on the color and colloids of cane juice: J. F. BREWSTER and W. G. RAINES.

The determination of color and decolorization in sugar products: H. H. PETERS and F. P. PHELPS. The degree of color introduced and decolorization obtained for sugar solutions was determined with a spectrophotometer. The difficulties encountered to create filtrates "optically void" out of impure sugar solutions led to the adoption of an analytical procedure. It is shown that the commonly practised mode of analytical preparation for colorimetric analyses leads to erroneous conclusions in regard to color introduced and removed; that consistent results can not be attained as the present criterion for "brilliant filtrates" is far from being synonymous with "filtrates optically void." Inert material employed in the analytical preparation, such as Kieselguhr, must not be used. It leads to selective action on different wave lengths; neither is its most brilliant filter-paper-filtrate "optically void." The final calculation of color in sugar products to a unit basis of "100 Brix, 1 cm." is proposed. The laws governing the application of the spectrophotometer and tint photometer are discussed and directions are given how to express color degrees obtained by other colorimeters on this unit basis. Graphs of transmission and absorption spectra are presented.

A discussion of the refractometer scale for the evaluation of syrups: F. C. ATKINSON. A discussion of the relative merits of both methods for the grading of glucose and other viscous syrups, being an argument for the adoption of the refractometer reading as the official standard for the commercial valuation of such syrups. This argument is based on the higher degree of accuracy, convenience and saving of time over the method now in vogue.

Preparation of mannose from ivory nut shavings: PAUL M. HORTON. In making mannose from ivory nut shavings, the syrup is usually gummy and difficult to crystallize. If, however, the shavings are extracted with sodium hydroxide before being hydrolyzed with sulphuric acid, the final syrup crystallizes from glacial acetic acid without difficulty. If crystallization is slow, it can frequently be hastened by freezing the solution under agitation and thawing slowly. Details as to concentration and temperature are also given.

Flask calibrating and marking device: G. L. SPENCER.

The preparation of a decolorizing char from sugar cane bagasse: C. E. COATES.

A revision of the optical method for analyzing mixtures of raffinose and sucrose: C. A. BROWNE and C. A. GAMBLE. Recent corrections by Steuerwald and by Schrefeld of the Clerget formula for the Herzfeld method of determining sucrose necessitate also a revision of the Creydt formulas for analyzing mixtures of raffinose and sucrose. In making this revision, the authors have redetermined the value of the constant for the invert polarization of raffinose and have also determined the values for the influence of temperature upon the polarizations of raffinose before and after inversion. Applications are given of the Creydt formulas as thus revised to the analysis of mixtures containing known amounts of sucrose and raffinose.

Preliminary note on the causes of caking in sugar: M. J. PROFFITT.

Investigation of conditions affecting the quantitative determination of reducing sugars by Fehling solution. Elimination of certain errors involved in current methods: F. A. QUISUMBING and A. W. THOMAS.

The standardization of rare sugars: H. T. GRABER.

The determination of ash in Cuban raw sugar: UEL S. JAMISON and JAMES R. WITHROW. Difficulty from foamover in ash determination can be eliminated by preliminary heating on electric hot plate before ashing in the usual muffle. A drop or two of vaseline oil also prevents foamover. The sulfate method of ashing used by the Bureau of Standards is found on Cuban raw sugar to give 38 per cent. higher results even with the usual 10 per cent. modification than its direct incineration. The various other ashing methods in the literature have been compared and a modification of the sulfate method suggested.

The quantities and properties of lead precipitates from different raw cane sugars: C. A. BROWNE and H. M. WILEY. A comparison is given of the specific gravities and PbO content of the dried sugar-free lead subacetate precipitates obtained from 3 Cuban centrifugal sugars and 4 Philippine concrete sugars. The lead precipitates from the Cuban sugars had an average sp. gr. of 2.47 and a PbO content of 46.85 per cent., and from the Philippine sugars an average sp. gr. of 2.74 and a PbO content of 49.56 per cent. For a normal

weight of 26 grams of sugar in 100 c.c. the volumes of the lead precipitates in the case of the Cuban sugars of polarization 90.95–96.00 varied from 0.10 to 0.12 c.c. and in case of the Philippine sugar of polarization 78.30–87.80 from 0.32 to 0.48 c.c. The volume of the lead precipitates was not found to increase during deterioration of the sugar.

1. *The saccharimetric graduation of polarimeters with a graduated circle which employ yellow sodium light.* 2. *The graduation of saccharimeters with a quartz compensation:* A. Jobin. The author employs as a basis for the saccharimetric graduation of his instruments the following fundamental values: + 66.5 for the specific rotation of sucrose for the D ray; + 21.7182 for the rotation of the standard 1 mm. plate of quartz for the D ray. The variations in these fundamental values with concentration of sugar solution, with temperature and with source of light are considered, and a mathematical discussion is given of the various corrections which need to be applied in the saccharimetric graduation of polarimeters and of quartz wedge saccharimeters. Light filters should serve not for unifying, but for purifying the source of illumination. The official rules relating to the bichromate filter should be revised.

Examination of sugar crystals by projection: George P. Meade. Samples of raw sugar from several factories are classified daily as to size and regularity of crystal. A "balopticon," with vertical attachment, throws an image of a small portion of the sample on a screen, magnifying ten diameters. Squares drawn on the screen correspond in size to an arbitrary scale of ten, and the observer compares the image of the crystals with the squares, determining the size to the nearest whole number of the scale. The projection also shows the regularity and form of the crystals, and abnormalities are noted.

The rare sugars, their purity and tests: R. B. Black.

A study of beet gum. (1) *Separation from final molasses:* H. S. Paine and C. F. Walton.

Solubility of dextrose in water: R. F. Jackson and C. L. Gillis.

Some observations from the beet sugar industry: H. E. Zitkowski.

Sugar filtration in factories and refineries: H. J. Runyon, Jr.

Colloids in beet sugar house liquors and products: H. S. Paine, C. G. Church and F. W. Reynolds.

Experiments with sugar cane seedlings in St. Croix: Longfield Smith. Experiments conducted during 1920 upon the St. Croix seedling canes—S. C. 12/37, S. C. 12/4, S. C. 14/93, and S. C. 13/13—gave in comparison with the standard ribbon cane grown for comparison alongside the following yields of cane and of sucrose per acre, as obtained by a small 3 roller mill driven by a 5 h.p. gasoline engine.

	Tons Cane per Acre	Pounds Sucrose per Acre
S. C. 12/37	35.7	7460
Ribbon alongside	27.3	5157
S. C. 12/4	31.5	6970
Ribbon alongside	28.4	5771
S. C. 14/93	36.9	6671
Ribbon alongside	31.5	5306
S. C. 13/13	38.3	6455
Ribbon alongside	32.1	6248

With a stronger mill such as used in a modern sugar factory the above yields of sucrose per acre would be at least 50 per cent. higher. The new St. Croix seedlings are excellently adapted to local conditions and are rapidly finding favor not only in St. Croix but in Porto Rico and other West Indian islands. The S. C. 12/4, when ripe, yields a juice containing 20 per cent. sucrose. The juice of ripe ratoons has been known to yield 24 per cent. of sucrose.

A precipitate obtained from cane juice after clarification with Kieselguhr and decolorizing carbon: V. Birckner.

Experiments with Schoorl's volumetric method for determining reducing sugars: C. A. Browne and G. H. Harden. In Schoorl's volumetric method for determining reducing sugars, the unreduced copper of the Fehling solution is determined in presence of the reduced Cu_2O by means of n/10 thiosulphate solution after acidifying with sulphuric acid and adding potassium iodide. The difference between the total copper originally present and the unreduced copper gives the copper reduced by the sugar. Applications of this method to the analysis of solutions of dextrose, maltose, lactose and sucrose are given, with comparisons of the results obtained by direct weighing of the reduced copper.

The continuous sampling of sugar liquors: W. L. Jordan.

Preparation of galactose: E. P. Clark.

The manufacturing of high purity crystalline anhydrous dextrose: C. E. G. Poyst.

Charles L. Parsons,
Secretary

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THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Robert A. Millikan, professor of physics at the University of Chicago, has been appointed director of the Norman Bridge Laboratory of Physics at the California Institute of Technology and chairman of the executive council of the institute. Dr. Millikan has for a number of years spent the winter term at the institute, but he will now give his whole time to it, beginning in October, when the new physical laboratory will be ready for occupancy.

Dr. Millikan will devote himself mainly to the development at the institute of a large and effective research laboratory of physics. The trustees, though prepared to appoint him president, were appreciative of his desire not to be burdened with the administrative duties which are usually attached to that office, and have created a new administrative board, to be called the executive council, which will combine the usual functions of the president and the executive committee of the board of trustees. This executive council will consist of six members, three from the board of trustees and three from the faculty, as follows: Robert A. Millikan, chairman; from the trustees, Arthur H. Fleming, president of the board; Henry M. Robinson, first vice-president of the board, president of the First National Bank of Los Angeles; and George E. Hale, director of the Mt. Wilson Observatory; from the faculty, in addition to Dr. Millikan, Arthur A. Noyes, director of the Gates Chemical Laboratory, and Edward C. Barrett, secretary of the institute.

Liberal provision, made possible by large gifts to the institute, has been made for the physical laboratory, for which an annual appropriation of $95,000 has been guaranteed. These funds will enable a large staff of able investigators and teachers and an unusually

complete equipment to be secured. In addition to this provision for annual support, the institute has recently received from Dr. Norman Bridge the promise of $200,000 for an extension of the physics laboratory and of $50,000 for its library.

It is also announced that the Southern California Edison Company will immediately erect at a cost of $75,000 on the campus of the California institute a high-tension laboratory where an extensive investigation on the transmission of power at high voltages will be made by the staffs of the company and of the physics and electrical engineering departments of the institute under the direction of Professor R. A. Millikan and R. W. Sorensen, and where other scientific researches will be carried on by the professors of the institute in cooperation with the Mt. Wilson Observatory.

A large project of research work will be at once undertaken, involving the close cooperation of the Mt. Wilson Observatory, the Norman Bridge Laboratory of Physics, and the Gates Chemical Laboratory of the institute. This research project will consist in a systematic attack on the most fundamental problem of physical science to-day—that of the constitution of matter and its relation to the phenomena of radiation. Further advance in these fields is to be expected, on the one hand, largely through the utilization of the most powerful agencies, such as enormously high temperatures and pressures, high-voltage discharges and intense magnetic fields; and, on the other hand, through the active cooperation of physicists, astrophysicists, mathematicians and chemists, whose combined viewpoints, knowledge, and experimental skill will contribute. These conditions already exist in large measure at Pasadena, but the scientific staff and the experimental facilities are to be so extended that the opportunities for the investigation of this fundamental problem will be exceptional.

It is also announced that, in order to supplement the work in mathematical physics now carried on by Professor Harry Bateman, Profesor H. A. Lorentz, of the University of Leiden, will be in residence as lecturer and research associate of the institute during two months of the winter term, and that Dr. C. G. Darwin, of the Univerity of Cambridge, has been appointed professor of mathematical physics at the institute for the college year of 1922–23.

THE COURSE IN GENERAL ZOOLOGY: METHODS OF TEACHING

Professor Shull has done a signal service to the teaching of general zoology by calling attention to the defects of the one-time prevalent "type course" and to certain advantages to be gained by basing the course on general principles. The kind of course deemed best by Professor Shull is indicated in his papers in Science[1, 2] and his recent "Principles of Animal Biology"[3] and "Laboratory Directions."[3] Professor Nichols[4] has discussed the relative merits of a course in general biology as compared with separate courses in botany and zoology, and Professor Henderson[5] has made a plea for the substitution of the study of human physiology for the study of animals and plants. Professor Colton[6] has discussed aim and incentive from the standpoint of the attitude of the student toward the subject. In none of these papers, however, has much been said as to fundamental *purpose* or *method.* Professor McClung[7] in his appeal for a discussion of the general course in zoology indicated that these subjects should receive predominant attention in any effort to arrive at a satisfactory conclusion as to how the course should be given. It is to the subjects of purpose and method, and especially the latter that the writer desires to invite attention.

It would seem to be self-evident that matters of content, arrangement and method should be determined by the aim or purpose

1 Science, December 27, 1918.
2 Science, March 26, 1920.
3 New York, McGraw-Hill Book Co.
4 Science, December 5, 1919.
5 Science, January 16, 1920.
6 Science, April 16, 1920.
7 Science, April 11, 1919.

for which the course is given. To a certain degree, also, the purpose should be influenced by the character and prospective careers of the students taking the course.

With regard to the latter consideration it may be assumed that in a majority of college classes in general zoology there are roughly two groups, one composed of those who will take no other courses in the subject but who are destined to enter upon a great variety of walks of life, and the other composed of those who will pursue the subject further, to prepare themselves to become physicians; teachers in high schools, colleges and universities; investigators or other kind of professional workers.

It may properly be asked whether it is possible to give a single course which will satisfy the needs of these different groups of students. The writer believes that an affirmative answer can be given. The general purposes in teaching zoology are necessarily identical with the aims of all education, namely, to make life more worth while for those who attend the schools by developing and training their mental faculties and by extending their knowledge of themselves and the world in which they live. The purposes thus include giving information of a valuable nature, and giving training. Nearly all of the scientific work being done in the world to-day is accomplished by persons trained in scientific methods; and it is the trained mind and hand that employers everywhere are demanding. Consequently training of the right kind should be of value to all classes of students while information or content may be varied to meet the more special needs of each class.

As to the nature of the training that should be given Professor Nichols has given an admirable statement:[4]

> The value to the student of biology or zoology as a cultural study lies quite as much in methods acquired and in facts observed as it does in information received. First and foremost the student should be taught to be careful in his technique, to be precise in his observation, to be thorough in his attention to details, to be keen in finding things for himself, to be accurate in his conclusions.

To these may be added—to make effective use of the English language. Surely no student, no matter how he may be planning his future, could fail to profit by a course which gave training in the qualities enumerated.

Is it not therefore necessary to select with care the method of teaching which will give the best results in accomplishing the kind of training indicated? The too-prevalent method of confirmation or verification, when used exclusively or combined with purely informative methods, can scarcely give the desired results. The so-called scientific method, involving so far as is practicable the method of discovery, must be employed if training for individual initiative or independence of thought is to be acquired. And unless the student does learn to think independently he can never take the leadership in the community for which his education should be his preparation.

The scientific method has been called the method of common sense extended and systematized. It involves the inductive process of drawing conclusions from observed facts. It is not only the basic method for all scientific work but it is applicable to almost every field of human activity requiring thought and judgment. In applying it there is assumed a purpose or goal to be reached or problem to be solved which is stated or described as clearly as possible. Then observations are made which may or may not be based on experiment. The observations are made with great care and as extensive as time and material will permit. The observations are recorded in some permanent and convenient form by the use of notes, drawings, models, charts, graphs, maps, or photographs, depending upon the nature of the material. The data thus secured are correlated and coordinated (synthesized) so that a conclusion may be drawn. Should not every course in a science give training in the scientific method?

As a further amplification of the views of the writer with regard to the use of this method in the course in general zoology, extensive references will be made to the course given at the University of Pennsylvania since the plans for this illustrate in a concrete way

the ideas that the writer desires to convey. With reference to this course it should be said that it was established upon the basis of "general principles" about twenty years ago when Professor Conklin was head of the department. The instructors concerned are therefore in hearty accord with Professor Shull's efforts to extend the employment of such a plan. For the past few years also a serious effort has been made to apply the scientific method throughout the part of the course devoted to laboratory studies and the results have more than justified the efforts in this direction. The laboratory work, occupying more than two thirds of the time devoted to the course is, consequently, presented to the student in the form of a series of problems framed as far as is practicable upon the method outlined above.

In deciding how the course should begin a number of purposes have been kept in mind. An effort has been made to lessen as much as possible the difficulties that students have in getting started on a new subject under entirely novel conditions. Contrary to the rather widespread practise of beginning with the cell or a protozoon, an animal is used at the start which is large enough to be seen without special equipment, since to get acquainted with the compound microscope constitutes no small task in itself. Another reason for taking a larger animal is that it is much more likely to fall within the range of the student's experience, and, further, since the student is accustomed to look at animals as individual entities, it is more desirable to present an entire animal than any part of it such as a cell or tissue. It is an open question whether it is better pedagogy to begin with the simple (cell—protozoa) and proceed to the complex (entire animal—metazoa) or to proceed from the more familiar (entire animal) to the less familiar (tissues and cells). As a result of their teaching experience the instructors giving this course have adopted the latter alternative. They are furthermore in agreement with Professor Nichols when he says:[4]

Let the student learn to be analytic before he attempts synthesis.

In choosing the first animal it has also seemed desirable to select one which is definite in its morphological characters and complex enough to afford a good test of the student's powers of observation.

With the foregoing considerations in mind an Arthropod, such as a grasshopper or crayfish, has frequently been chosen and used with much success. At the beginning the student is asked to study carefully a specimen of the chosen animal and to make two pictures of it; a word picture, thus permitting him to use his most familiar tool of expression, his language; second, a picture in the form of a drawing. He is asked to organize his description carefully, make an outline of it and then write it out, using the best English at his command. He is asked to compare his two pictures and decide which is the more accurate: this is the problem set for him to solve. Almost without exception the student perceives that the drawing furnishes a much more accurate picture of the animal than does his description and thus some of the objections that students are accustomed to make to the requirement of drawings are met and disarmed at the very outset.

Then through a series of problems the student is asked to determine in an analytical way the external anatomy of the animal, recording his observations in the form of fully labelled drawings. At the end he is asked to integrate his information into an essay upon the specimen as a whole animal.

This study is followed by an exercise on classification most of the material for which the student collects for himself. Next a vertebrate, such as a frog, is introduced to give a better basis for the subject of general physiology, which is presented primarily from the standpoint of human physiology, but also with reference to the animal which is being dissected. The student is thus introduced to the more general morphological and physiological characteristics of living things, is brought to see the application of these principles to his own body and mind, and perceives the funda-

mental similarities between himself and the lower organisms, the latter represented by his laboratory specimens.

Next the student is given an "unknown" vertebrate to study. For the most part the student is placed on his own responsibility and judgment in handling the new specimen, his problem being to determine and record facts in the best possible manner, and to make intelligible to any one unfamiliar with it, the appearance and organization of the new animal. Having been given a method with the earlier specimen he is expected to apply it to the second. A large majority of the students give a ready response to this appeal to their individual initiative and to the opportunity for making discoveries for themselves. In some cases an interest which may have been lagging is stimulated into renewed and sustained activity.

The compound microscope is next introduced by a special problem on the use of the microscope, and this is followed by the study of cells and tissues. Then follow in succession studies on embryology, cell division, maturation and fertilization, with especial attention to the behavior of the chromosomes. But since the complex behavior of the chromosomes in mitosis, maturation, and fertilization is most satisfactorily explained as the mechanism for the behavior of mendelian factors, the subject of heredity, and especially mendelism, is considered along with these morphological studies. A book on heredity, such as that of Conklin[8] or that of Guyer[9] is read by the student and he also carries out a breeding experiment with *Drosophila*.

Next an evolutionary series is presented consisting of representatives of the protozoa, cœlenterates, flat worms and annelids, followed by other studies illustrating evolution. In addition to furnishing evidences for organic evolution, the series is made to illustrate a variety of biological principles, further details about which will, for the sake of brevity, be omitted here.

These objective studies are handled in the form of problems based upon the scientific method previously outlined. As the course develops and the student gains in experience he is placed more and more on his own responsibility as to methods of procedure and record, thus permitting him to apply the lessons in method that have been learned. In addition to training in method, the student gains through these studies much of the information that he is supposed to acquire, and gains it in a way that will make it of the most value and permanency for him. Additional information is conveyed through lectures, quizzes, and assigned readings, so selected and arranged as to emphasize general principles and to contribute to the "unity and balance" of the course.

Since the scientific method is more time-consuming than other methods, its use imposes rather definite limitations upon the amount of ground which may be covered in any given time. But the results have been so much more satisfactory than those secured by other methods that the instructors giving the course feel that its use is thoroughly justified.

D. H. WENRICH

ZOOLOGICAL LABORATORY,
UNIVERSITY OF PENNSYLVANIA

8 "Heredity and Environment," Princeton, Princeton University Press.

9 "Being Well Born," Indianapolis, Bobbs-Merrill Co.

LOUIS ALBERT FISCHER

LOUIS ALBERT FISCHER, physicist and chief of the Division of Weights and Measures of the United States Bureau of Standards, died at his home in Washington on July 25, aged fifty-seven years. Early in life he joined the old weights and measures office of the U. S. Coast and Geodetic Survey. During this period he compared the standards of length in the custody of the national government with the standards submitted for test by manufacturers, educational institutions, and the various state weights and measures bureaus. The duties of this position also included the standardization of weights, the ordinary weights of commerce as well as the weights

used in the most precise work of the analytical chemist, and the standardization of thermometers and of surveyors' tapes used in precise geodetic measurements. This early work laid the foundation for the establishment of the National Bureau of Standards in 1901, in the creation of which he took a conspicuous part. At the organization of that Bureau, he was chosen as chief of the Division of Weights and Measures, a position which he has since filled with distinguished honor. In a life, crowded with important administrative responsibilities, he had, nevertheless, found opportunity to carry on scientific researches which have won for him recognition as one of the leading American metrologists. He built up in the Bureau of Standards a strong division of weights and measures, from which have come many valuable scientific and technical contributions. Owing to the limitation of space, I can only refer to a few of these here, but many will recall the investigations and papers relating to the densities of aqueous alcoholic solutions, the standardization of chemical glassware, the thermal expansivities of metals, alloys, and dental amalgams, the testing of clinical thermometers, the comparison of the national prototype meter with the international meter, the testing of watches, model laws for state weights and measures services, specifications for railroad track scales, the standardization of screw threads, gauges, etc. In many of these papers he shared the honors of authorship and all of them bear the impress of his inspiring and forceful leadership.

In 1905 Fischer organized the Annual Conference of Weights and Measures of the United States and he has since been the secretary of that organization which includes national, state, and municipal officials and others interested in the promotion of wise and uniform legislation and regulations relating to weights and measures. His advice and opinions have been sought by officials dealing with these matters in every state in the Union and probably no man in this country has had so profound and far reaching an influence in all matters appertaining to weights and measures in the past decade. He has for many years been annually designated by the president to serve on the commission entrusted with the responsibility of testing the "fineness" of the coinage, and he has, on numerous occasions, been invited to testify before Congressional Committees on Coinage, Weights and Measures.

Shortly after the entrance of this country into the World War, Fischer was chosen and commissioned a major in the Ordnance Department of the U. S. Army and was placed in responsible charge of the important section of gauge design. Here again his remarkable abilities as an administrator and organizer, combined with his tireless energy, enabled him to make a highly efficient organization out of a hastily assembled personnel, that was necessarily built up on the basis of quick but discriminating judgment. The value to the nation of his broad scientific grasp of his subject, of his engineering and technical training, of his unerring judgment, and of his untiring devotion to duty in this position can hardly be overestimated.

Fischer was a graduate of the George Washington University, a member of the American Physical Society, of the Physical Society of France, of the American Society of Mechanical Engineers, of the Washington Academy of Sciences; member and past-president of the Philosophical Society of Washington, and fellow of the American Association for the Advancement of Science. For many years he has been an active member of the Cosmos Club and of the Columbia Country Club.

He was a lover of clean and manly sports and achieved distinction as an athlete. In his early manhood he was a noted oarsman, winning many honors for the Potomac and Analostan Boat Clubs in local and national regattas. Rather late in life he took up tennis and soon won recognition as one of the leading tennis players of Washington, representing the Bachelors', the Dumbarton, and the Columbia Country Clubs in many local, intercity, and interstate tournaments.

Fischer, like his distinguished colleague Rosa, who died only a few weeks before, be-

longs to that group of public officials, growing increasingly prominent in the scientific and technical services of the government, who willingly forego the rewards and comforts that their brilliant abilities might easily win for them in other walks of life, in order that they may follow the highest ideals of their profession. In the example of his splendid life, in the influence of his wise and unerring judgment and counsel, and in his splendid idealism, Fischer will continue to live on, in the years that stretch out before, in the memory of those whose lives were enriched by his friendship.

C. W. Waidner

SCIENTIFIC EVENTS

THE BRITISH NATIONAL PHYSICAL LABORATORY

The report of The British National Physical Laboratory for 1920, which was recently issued, gives a survey of the work carried out in the various departments during that year, and also a statement of the program for 1921–22.

From the abstract in the London *Times* we learn that in regard to testing work, the charges for which have been revised owing to increased cost, the number of tests made in some departments was considerably smaller than in the preceding year and even than in the year before the war, though in others an increase is recorded. Of clinical thermometers no fewer than 1,598,100 were tested, and it is interesting that there has been a steady improvement in the quality of the instruments since the introduction of the order requiring them to be submitted to test.

In spite of the falling off in the routine work of certain sections, the activities of the laboratory continue to grow, and the demands upon it are likely to be increased in consequence of the steps taken by the government for the establishment of coordinating research boards for physics, chemistry, engineering, and radio research. The Radio Research Board has drawn up and approved a scheme of research to be carried out at the laboratory, and the Physics Research Board has also indicated certain lines of research which it is considered desirable the laboratory should take up. Some additions to the buildings have been authorized and others are under consideration. The space available for extension is, however, very limited, and accordingly measures have been taken to secure land for building purposes immediately adjoining the laboratory grounds.

As usual, in addition to researches of a general character, the laboratory has in hand various special investigations for government departments and other bodies. The Photometry Divison, for example, has undertaken experiments on ships' navigation lamps for the Board of Trade, on miners' lamps for the Home Office, and on motor-car head lamps for the Ministry of Transport. It is assisting the Office of Works in connection with the lighting of government offices, museums, and other buildings. Experiments have been made for the purpose of securing adequate illumination on the walls at the National Gallery, while avoiding direct sunlight and of diminishing as far as possible reflection of objects and people in the glass covering the pictures. Measurements in the Houses of Parliament have shown that, especially in the House of Commons, the illumination is very low—less on the average than the equivalent of one candle at a foot, whereas it is usually considered that three or four times as much should be provided for the easy reading of such matter as manuscript notes.

RESOLUTIONS OF THE MEDICAL BOARD OF THE JOHNS HOPKINS HOSPITAL

The resolutions limiting the fees of surgeons operating at the Johns Hopkins Hospital to $1,000 and fees for hospital visits to $35 weekly, recently passed by the trustees on the recommendation of the Medical Board, are as follows:

Whereas, the trustees of the Johns Hopkins Hospital desire that all patients may leave the hospital feeling that they have received not only proper professional, nursing and administrative service, but also that they have been dealt with fairly in every particular, including charges for medical and surgical service; and

WHEREAS, the trustees believe that the members of the staff likewise desire this result and will continue to cooperate in carrying out the policy of the hospital as considered for the best interest of the patients and the hospital; therefore, be it

Resolved, That the following regulations be adopted:

1. That members of the staff shall bring promptly to the attention of the director of the hospital any conditions or circumstances which they feel justify criticism and should be corrected, also any just complaints uttered by their patients or the friends and relatives of patients, applying either to the professional service or to the management.

2. That all fees to be charged for services rendered any patients in the private rooms of the Hospital shall be subject to the jurisdiction of the committee on fees, and shall in no case exceed the amounts stated below, except where the consent of said committee shall have been obtained; it being understood, however, that all fees charged shall in no case impose a hardship upon those responsible for their payment and shall be arranged in advance of admission wherever possible, or as soon thereafter as possible.

(*a*) Professional service by physicians, $35 per week, which includes at least three visits by the patient's physician.

(*b*) Consultation fees, $25.

(*c*) Maximum fee for major operation, $1,000.

(*d*) No consultation fee shall be charged patients entering the public wards when the examination has been made anywhere in the hospital.

3. That not more than 10 rooms shall be at the disposal of any one member of the staff at one time if the private rooms are in demand by other members of the staff having the same privilege.

THE HUNAN-YALE COLLEGE OF MEDICINE

ON June 18, eleven Chinese young men received their M.D. degrees at the Hunan-Yale College of Medicine at Changsha, China. This medical college is part of the educational enterprise known as "Yale-in-China," the first of the American institutions overseas to be launched by and to bear the name of the alma mater.

In 1900, Hunan Province was closed to foreigners. Its wealth of resource, its educational traditions, the caliber of its men, were all known; but no Westerner was desired inside. On July 28, 1903, a treaty threw its capital, Changsha, open to the world. Soon after, it was decided to establish there the educational work of Yale University.

Starting with a class of high-school freshmen in 1906, Yale-in-China now includes a College of Arts and Sciences, authorized by the Connecticut legislature to grant degrees; a Preparatory School; a modern medical college, with associated hospital and school of nursing. The student enrollment is nearly 400.

In 1913 a modern hospital was promised by a Yale graduate; and the assurance of this gift so stimulated the Chinese of this interior capital city that they formed a society for the promotion of medical education. A joint local board now administers all the medical work, and the Hunan government makes an annual grant of $50,000 silver. In addition, generous grants are received from the China Medical Board of the Rockefeller Foundation and from the Commonwealth Fund.

The medical college requires two years of pre-medical science laboratory work, and grants the medical degree only after five years of study, the fifth being largely a hospital year.

The graduation in June was the first in the medical college and was a memorable occasion, large numbers of Chinese officials being present in recognition of the fact that this institution stands conspicuous in China as representing a true Chinese and American cooperation.

The Medical Advisory Board includes Dr. W. B. James, chairman, Dr. W. H. Welch, Dr. John Howland, Dr. S. W. Lambert, Dr. F. T. Murphy, Dr. George Blumer, Dr. Harvey Cushing, Dr. R. P. Strong and Dr. A. D. Bevan.

A NEW MUSEUM AT CASTINE, MAINE

NEAR the site of the first French settlement (1611) at Castine, a museum is being erected. It is 75 feet in length, about 35 feet deep and is flanked by a terrace overlooking Castine Bay. The construction is fireproof and the building will have objects of historical

importance as well as a large collection of the artifacts, utensils, weapons, etc., of prehitoric man here and abroad.

Dr. J. Howard Wilson and his mother, Mrs. J. B. Wilson, are the donors. Rather than place his important exhibits in some of the larger museums, Dr. Wilson preferred to give the citizens of Castine this modern structure and interest them in the beginnings of human culture as well as preserve their own priceless historical relics. It is quite fitting that the building-lot adjoins the famous Fort Pentagoet site.

The building and endowment of local museums should be encouraged, since by that means knowledge is more generally disseminated than through the larger museums.

By November the structure will be completed, and it is proposed to have it dedicated some time next spring. Dr. Wilson's collections total many thousands, and there are numerous French, English and colonial objects in Castine which are available for exhibition.

SCIENTIFIC NOTES AND NEWS

Walter G. Campbell, assistant chief of the Bureau of Chemistry since 1916, has been appointed acting chief to fill the place of Dr. Carl L. Alsberg, who resigned to become one of the directors of the Institute for Food Research at Stanford University. Dr. W. W. Skinner, chief of the water and beverage laboratory of the bureau since 1908, has been designated as assistant chief.

Dr. Roscoe Thatcher, who succeeds Dr. W. H. Jordan as director of the New York State Agricultural Experiment Station, has taken up his work at Geneva.

Drs. George Dock, St. Louis; Otto Folin, Boston; and Ludvig Hektoen, Chicago, have accepted appointments as consultants to the National Pathological Laboratories to advise on methods used, interpretation of results and ethical policies.

David Prescott Barrows, president of the University of California, has been appointed a member of the National Research Council for a period of three years in the Division of States Relations.

We learn from *Nature* that at the meeting of the Royal Society of Edinburgh on July 4 the following were elected honorary fellows: —*British:* William Henry Perkin, Sir Ronald Ross, Sir Ernest Rutherford and Sir Jethro J. H. Teall. *Foreign:* Reginald Aldworth Daly (Cambridge), Johan Hjort (Bergen), Charles Louis Alphonse Laveran (Paris), Heike Kamerlingh Onnes (Leyden), and Salvatore Pincherle (Bologna).

On June 22 a portrait of Sir Napier Shaw, painted by W. W. Russell, was presented to him by the staff of the Meteorological Office, South Kensington, for preservation in the office. A copy of the portrait was presented to Lady Shaw.

An International Hydrographic Bureau has been established at Monaco, with the following directors: Vice-Admiral Sir John Parry (Great Britain), Captain Phaff (Netherlands), and Captain Muller (Norway). The secretary is Captain Spicer-Simson (Great Britain).

Colonel Thomas Sinclair, professor of surgery in Queen's College, Belfast, is among the twenty-four members elected to the senate of the Parliament of Northern Ireland, and Sir Thomas Joseph Stafford, late medical commissioner, Local Government Board, Ireland, is elected to the senate for the Southern Parliament.

A French society "for encouragement *du bien*," recently awarded a civic crown to the Institut Pasteur at Paris, and presented it to Dr. Roux as the representative of that institute.

The trustees of the Beit Fellowships for Scientific Research, endowed in 1913 by Sir Otto Beit, to promote the advancement of science by means of research, have elected to fellowships Messrs. H. L. Riley and W. A. P. Challenor. Both will carry out research at the Imperial College of Science and Technology at South Kensington.

Professor and Mrs. E. W. D. Holway, of the University of Minnesota, sailed from New

York City on July 23, for Rio de Janeiro, Brazil. They have planned a two-years' trip for the collection of plants and especially the rusts. They expect to cross the Andes early in the coming year, and spend the remainder of the time on the west coast.

Dr. Frank T. McFarland, who has been spending his sabbatical leave at the University of Wisconsin investigating the relationships of the various claviceps, has returned to the University of Kentucky as head of the Department of Botany.

Professor George F. Sykes, of the department of zoology and physiology in the Oregon State College, will spend a sabbatical year in travel, study and literary work, during which his address will be Warren, Rhode Island.

Dr. Frederick Starr, of the University of Chicago, is giving a series of illustrated lectures at the university as follows: August 5, "Aztec Mexico"; August 12, "Modern Mexico"; and August 19, "Mexico to-day."

Dr. Winthrop E. Stone, since 1900 president of Purdue University, and previously professor of chemistry, fell from a cliff near the summit of Mt. Eanon, Alberta, on July 16, and was instantly killed. Dr. and Mrs. Stone had nearly completed the initial ascent of the mountain when the accident occurred.

Professor Alfred Monroe Kenyon, head of the mathematical department of Purdue University, died suddenly at Ashland, Ohio, on July 27, while returning to Lafayette, Ind., by train after attending the funeral of his mother. Professor Kenyon was 52 years old.

Charles Barney Cory, curator of zoology in the Field Museum of Natural History, died on July 29, at the age of 64 years. Mr. Cory was one of the founders and a past president of the American Ornithologists' Union, a member of many societies, and widely known for his ornithological writings.

Charles Howard Royce, extension professor of animal husbandry at the New York State College of Agriculture, Cornell University, died on August 5, as a result of injuries suffered in a fall from a silo on his farm here on July 11.

Edmond Perrier, director of the Museum of Natural History in Paris, died on August 1, aged seventy-seven years.

Professor Kraepelin, of Munich, announces that the Institute for Research in Psychiatry, of which he is director, has received gifts and bequests this year totaling over 1,500,000 marks, and the collections and the library have also been notably enriched by gifts.

According to an announcement made by the secretary of the New York Association for Medical Education, Dr. Otto von Huffman, the Carnegie Foundation has offered to make a donation of $12,000 to the association on condition that the medical profession shall raise $3,000. The raising of this sum will enable the association to continue its activities which have been curtailed of late because of lack of funds. This association was organized two years ago to collect information in regard to postgraduate medical instruction and to develop such courses.

Instructions have been issued to the representatives of the Bureau of Fisheries on the Pribilof Islands authorizing the taking of 30,000 fur-seal skins on both islands during the calendar year 1921. Tentative divisions by classes for the killings on the two islands are as follows: St. Paul, 22,100 three-year-olds, 3,000 four-year-olds, and 600 five-year-olds; and St. George, 2,750 three-year-olds, 450 four-year-olds, and 100 five-year-olds. As the season progresses some readjustments as to numbers of the various classes may become desirable as the result of observations on the ground. The regular summer sealing season ended on August 5, instead of continuing until August 10, as heretofore.

An interdepartmental conference was held on July 25, in the Interior Department building, Washington, D. C., to discuss the status of patients arising within the government service, the intention being to formulate a coordination of the views now held in the various bureaus and departments upon this subject, and to work out some concerted method of procedure for handling the patients here considered. Mr. E. C. Finney, assistant

secretary of the interior, presided at the conference, which was held at the suggestion of the secretary of the interior and was composed of representatives from the various executive departments. After a general discussion of the subject under debate, two committees were appointed to go into the matter further and to report to a similar conference to be held at some future date. A committee of five is to consider in detail ways and means for the coordination and procedure work above suggested, and a committee of three is to develop a plan to provide a general clearing house for the dissemination of information among the several executive departments with respect to licenses, shop rights, and titles, which the Government has acquired, or may acquire with respect to patients.

Announcement is made that it is the policy of the War Department to encourage the development of military inventions by officers, enlisted men and civil employees. In consideration of assistance to be given by the department in the issue of patents, it will require of inventors a license to manufacture and use their inventions for governmental purposes, thereby reserving to the patentee complete freedom and ownership of the patent in its commercial applications. In special cases of inventions of great military importance, however, provision is made for exclusive government ownership and the utmost secrecy.

The New England Intercollegiate Geological Excursion will be held on October 14 and 15 in the vicinity of Attleboro, Massachusetts, under the leadership of Professor Jay B. Woodworth of Harvard University.

UNIVERSITY AND EDUCATIONAL NOTES

At a recent meeting of the board of regents of the University of Oregon, it was decided to place contracts immediately for the construction of the new medical school building in Portland. It was also decided to name the medical school building after the late Dr. Robert C. Yenny.

St. Louis University is erecting a new building, 50 x 200 ft., three stories high, as an extension to the medical school. Accommodations will be afforded for the library, reading room, administration offices and the laboratories for physiology, pharmacology and histology. In addition to this the old building is being remodeled so as to give more adequate accommodations to the other departments.

By the will of Seymour T. Coman, of Chicago, the residue of his estate is bequeathed to the University of Chicago for scientific research with special reference to the cause, prevention, and cure of disease. The fund is to be known as the Seymour Coman Research Fund.

At the Harvard Medical School Dr. Alexander Forbes has been promoted to be associate professor of physiology, and Dr. George Cheever Shattuck to be assistant professor of tropical medicine for a one-year term.

Major Hugo Diemer, formerly professor of industrial engineering at Pennsylvania State College and later personnel superintendent at the Winchester Repeating Arms Co., New Haven, has been appointed director of the industrial management division of LaSalle Extension University, Chicago, Ill. The division includes the resident and correspondence instruction in industrial management efficiency, modern foremanship and production methods and personnel administration, as well as the consulting service in each of these departments.

Dr. Arthur J. Tieje, who received his doctorate from the University of Minnesota in 1920, has been appointed assistant professor of geology at the University of Colorado, and assistant geologist on the Colorado Geological Survey.

Professor Maurice DeWulf, formerly of the University of Louvain and sometime teacher in Harvard and Lowell lecturer, has accepted a permanent appointment as professor of philosophy at Harvard.

DISCUSSION AND CORRESPONDENCE

"DENUDATION," "EROSION," "CORROSION" AND "CORRASION"

The recent article by Professor M. H. Bissell[1] on the use of the terms "denudation," "erosion," "corrosion" and "corrasion" expresses a need which is felt by most instructors of elementary classes in geology and physiography. In the opinion of the writer the confusion of terms is attendant on a confusion of ideas concerning three very essential topics discussed in any elementary class, namely, weathering, denudation, and deposition.

The geologic agents of denudation and deposition are practically identical. Hence it is logical to discuss the denudational and depositional work of the wind, running water, underground water, the ocean, ice, and gravity. It seems to the writer, however, that the practise of placing a discussion of weathering in a chapter entitled "The work of the atmosphere" is very confusing. The agents of weathering are quite distinct from those of denudation and deposition, and require separate treatment. It is very difficult to show the connection between the work of the atmosphere and exfoliation. It is poor physics to teach that the expansion and contraction of rocks is due to the atmosphere.

The writer would define weathering as the alteration of rocks rendering them liable to transportation by the dynamic forces having their origin near the surface of the earth. Wind, water, ice, and gravity can not transport bed-rock. But when bed-rock is broken down by the chemical and mechanical activity of weathering, its particles may be transported.

In a similar way, denudation might be defined as the removal of the products of rock weathering by the dynamic forces having their origin near the earth's surface. The process involves the lowering of the earth's surface by the combined actions of erosion and transportation. Erosion may be subdivided into two processes: (1) the mechanical wearing away of rocks (abrasion) by wind, running water, ice, and gravity; and (2) the chemical loss (corrosion) due to agents present in passing streams of water and air. The central idea expressed by the term "denudation" should involve the erosion and transportation of rock debris from its source to a position below baselevel.

[1] Science, April 29, 1921.

The word "corrasion" appears to be so similar in usage to the term "erosion" that it should be discarded in favor of the commoner term.

The writer believes that the average geologist has not departed very far from the root significance of the terms discussed by Professor Bissell. The development of the term "weathering," however, has outrun its original meaning, and processes are included which are not connected with atmospheric action.

A diagrammatic outline for class discussion of these topics might be the following.

- Weathering
  - Water
    - Mechanical (frost)
    - Chemical (hydration, oxidation, etc.)
  - Heat and cold, mechanical (exfoliation)
  - Atmospheric gases, chemical (oxidation, carbonization, etc.)
  - Plants
    - Mechanical (root growth)
    - Chemical (acids from roots and decay)
  - Animals
    - Mechanical (digging, burrowing)
    - Chemical (acids from decay and excreta)
- Denudation and Deposition...
  - Wind: Erosion, transportation, deposition
  - Running Water: Erosion, transportation, deposition
  - Underground Water: Erosion, transportation, deposition
  - Ice: Erosion, transportation, deposition
  - Gravity: Erosion, transportation, deposition

It may appear that the chemical activity of water in weathering, and of running water in denudation, are one and the same thing, but it

would appear to the writer that a distinction can be drawn between the static agent on the one hand, and the moving agent on the other.

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A POSSIBLE FACTOR IN THE INCREASING INCIDENCE OF GOITER

IN my surveys of industrial hygiene I have noted that at some of the salt works in Ohio, where the material is obtained from deep wells (which in pioneer days were widely known springs, and the gathering points of men and animals), bromine, and a trace of iodine, are separated out of the purified product, sodium chloride, and bromine sold as a by-product. I suspect that in inland countries, Nature's chief source of iodine has been in connection with these salt springs, wells, and "licks," and that perhaps this change to a deep source of salt and this purification has resulted in the quite complete absence of iodine from our daily condiment when obtained from inland manufacturers, that is, in package or carton through the avenues of commerce.

It is well known that sea salt, some sea foods, and sea growths contain iodine. Also there is only a limited amount of goiter among dwellers along the seas. Furthermore, in former times a considerable part of the salt used has been sea salt, simply crystallized, and not necessarily pure sodium chloride separated from the other halogen salts.

At first this theory does not seem plausible in connection with the historical incidence of goiter, cretinism, and other manifestations of hypo-thyroidism, noted in the Alps and associated mountain regions, wherein are located some of the largest salt mines in the world. However, Molinari in his "Inorganic Chemistry," as translated by Dr. Ernest Fielmann (1912), takes occasion to explain that while these great salt beds were originally naturally deposited from sea waters, they have had the composition of the deposits very materially changed during the ages, through the varying solubilities of the halogen compounds (sodium iodide being particularly soluble and therefore among the first to be washed out through the influence of percolating waters). Hence perhaps inhabitants of these regions, getting their salt from these localities, have been bereft of the associated iodine component so essential to the human economy.

As is well known, Marine and Kimball published remarkable effects of the administration of a few grains of sodium iodide several times a year to school children as a prophylaxis in goiter.[1] After communication with two or three authorities I am convinced that this suggestion concerning goiter has not been heretofore considered. Also in an investigation of literature at hand, I have been unable to find that any consideration has been given to the influence of a condiment composed of whole sea salts upon goitrous conditions. Should any one be so informed, I shall be pleased to hear from him, inasmuch as I have determined to spend a little time this summer in investigating the subject from the industrial end.

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THE SOCIAL ASPECTS OF COUNTRY PLANNING

FOLLOWING in the wake of city planning now comes country planning. As the face of the country differs from the face of the city, so country planning in some respects will differ from city planning. The social aspects of the planning idea as applied to country living conditions, are so important that a study of these aspects should rank as a sociological contribution of the first order.

Such a study is under way in the Division of Farm Life Studies, Office of Farm Management and Farm Economics, U. S. Department of Agriculture. The first step in the study is finding out the location of a few of the best instances or examples of outdoor country art and country planning in the United States—especially instances arising from the initiative of farm or village populations. The next step is to obtain a description and history of each from the person who has been connected with, or has close personal

[1] *Jour. Amer. Med. Assoc.*, Vol. 71, No. 26, pp. 2155, Dec., 1918.

knowledge of, the enterprise. This fund of information will give a basis for studying the social effects upon the farm population itself, and of estimating the special value of a policy of country planning in the development of country life in America.

The kinds of examples of country planning which the division of Farm Life Studies is particularly desirous of locating are as follows: Country parks (not State or Federal) for country people, outside villages and cities; public reserves in the country, that is, spots of natural beauty or of historic interest reserved for public use either through private benefaction or by local government; "gateways" to town or village from the farming country—that is, improved fringes of towns and villages, where highways lead from the farms planned and maintained through private or public means; colonization planning by land companies, which provides beforehand for better adjustments of rural community life; special outdoor art features, such as may be illustrated by certain farm athletic fields, farm roadside tree plantings, country bulletin boards, country cemeteries, community buildings, detachment of farm houses from farm work by screening effects.

The technical landscaping phases of country planning are promoted by the Bureau of Plant Industry, U. S. Department of Agriculture. The technical side of country planning, highly important indeed in its place, is not, however, a subject of inquiry in the present study. On the other hand, the human conditions and motives which lead to outdoor art improvements or which on the other hand, prevent or retard such improvements among American farm population groups, are the immediate aim of the study. There are presumably inducements to a country art movement not now generally recognized. There are possibly social values in country art which may become convincing to farmers when once analyzed. The result will doubtless increase the demand in farm communities for the outdoor art technician.

It will help to forward this work if any one conversant with the particulars of any outstanding instance of the foregoing phases of outdoor country art, will send some account, and photograph or other pictorial representation of the same, to the undersigned.

C. J. Gilpin

U. S. Department of Agriculture

QUOTATIONS

CUSTOMS LEGISLATION IN ENGLAND

So far as makers of scientific apparatus are concerned, we believe they are not satisfied with import duties, and want prohibition of import for a time, with permits to import in special cases. Many consumers have stated their preference for a system of subsidies to enable prices to be low enough to compete with foreign goods. Such a scheme naturally offers difficultes, and there would need to be assurance that efforts at improvement are being made. There seems to be no reasonable objection to the price being made as nearly as possible equal to that of the foreign article, so that the competition should become one of quality. The bill, however, will probably be passed, although it may still be possible to insert provisions to enable free import to recognized scientific institutions. Such permits must be of a general character, not requiring renewal, and not demanding the intervention of the customs or other government department. No special licenses for individual cases would be satisfactory.

How obstructive to scientific progress the customs regulations may be is shown by letters that have appeared in these columns. The question of books is a very serious one. Incidentally, reference may be made to the increasing difficulty of publication of scientific papers, which seems to be greater in England than in other countries. But here again what is wanted is a general fall in prices, and this can be brought about only by a return to normal trade relations throughout the world.

Much stress was laid by certain speakers in the House of Commons on the necessity of our industries as a national insurance in case of future war. The only remark that need be made in this place is that the most important matter is to keep abreast of scientific work in other countries. Restriction of research is

likely to do more harm than the more or less ineffective artificial protection of a few industries would do good. It is to be hoped, therefore, that institutions in which such scientific research is carried on will be placed beyond the effect of the new restrictions on import.—*Nature.*

SPECIAL ARTICLES

THE PRACTICAL SIGNIFICANCE OF THE REVOLUTION OF THE EMBRYO IN APHID EGGS

In 1916 W. F. Turner[1] and the writer published a paper on the green apple aphis, in which certain studies on the embryology of the species were reported. Studies on other species have since been completed and it seems now worth while to point out the important bearing that certain phases of the embryonic development have on the hatching of the egg under varying conditions. This seems especially urgent from the viewpoint of control in the egg stage.

As pointed out by Baker and Turner, the egg envelopes in the three common apple species, *pomi, malifoliæ* and *prunifoliæ* (*avenæ* of American authors) are two in number, the chorion which is thick and glossy black in color and the vitelline membrane which is delicate and transparent. At the time of deposition the egg is embedded by the female in a viscid material which serves to hold it in place on the twigs. This soon hardens and firmly fastens the egg in its location. This material covers irregularly all eggs and serves not only to cement them to the twigs but also as a protection for the chorion during the winter. It no doubt corresponds, in the Aphiinæ to the waxen coating with which the females of the Eriosomatinæ cover their eggs. A somewhat comparable condition is met with in other insects in which a glutinous cap covers the micropyle-area and may extend as an envelope over the greater part or even the entire egg.

The eggs of all three species when laid are of a somewhat greenish color and this changes ultimately to the glossy black of the wintering egg. This change in color coincides with preliminary embryonic development. This usually occupies about five day's time. Eggs which are infertile or in other ways abnormal do not change color in the usual way. In fact most infertile eggs are not of the normal green color when laid but have an orange or brownish tinge which may darken with age.

One of the most interesting phases in the development of these aphids is the resting stage of the embryo. All eggs, no matter whether laid early or late, reach this same stage for wintering. This is the normal dormant condition. The embryo lies in the center of the egg with its cephalic portion toward the posterior pole. The caudal half of the abdomen is reflexed dorsad in such a manner as to include the ovarian yolk. Segmentation is well marked and the formation of the appendages has begun. The stomatodeum and proctodeum are present while the formation of the mesenteron has begun. The genital rudiments are separated into two groups but the ovarian yolk is not yet divided and at the posterior pole lies the polar organ.

In this condition the embryo, especially of *pomi* and *malifoliæ,* remains until early spring and it must remain in this condition throughout the winter until normal growth is resumed. Attempts to force the eggs to their spring development are without success.

In the early spring development is resumed. This takes place in the vicinity of Washington, about the middle of March with *pomi* and *malifoliæ.* This development is accompanied by a movement of the embryo through the yolk toward the posterior pole until that portion of the amnion which lies above the head comes in contact with the serosa at its junction with the polar organ. The two envelopes then rupture here and the embryo revolves. This is a most important period in the development of the species and the time of this revolution is of great significance in understanding certain results which have been obtained by different workers.

It has been shown by Baker and Turner that an elevation of temperature before revolution is fatal to the embryo. It is also im-

[1] *Journal of Agricultural Research,* Vol. V., No. 21.

portant to remember that after the revolution of the embryo the eggs are much more susceptible to contact and similar injury. Recently Peterson[2] has published an important paper on the hatching of the eggs of these species, but he has apparently failed to note the fact that the time of revolution is extremely important in interpreting the results of experiments. It is very probable that the revolution of the embryo in New Brunswick takes place considerably later than in Washington. Judging from the conditions this would in all probability begin during the first week in April. It is evident then that in eggs taken during most of March and possibly some of those taken early in April the embryos would still be in the resting stage. Under such conditions eggs placed under a high temperature for hatching purposes would fail to hatch as all the embryos would be killed. In examining Peterson's Table I., p. 16, it will be seen that out of 4,400 eggs of *pomi* taken on March 14, not an egg hatched at 80° F., whether in dry air or in different percentages of saturation. Other eggs taken on April 6, gave a variable percentage of hatch. In dry air (expt. 105) some hatching occurred and also in 63 per cent. and 100 per cent. of moisture, but in 22 per cent. moisture (expt. 106) no hatching occurred. It seems probable that many of the embryos in the eggs used had not revolved and that more such eggs were present in experiment 106 than in experiments 105, 107 and 108. In fact these results seem to contradict Peterson's conclusion for more hatched in dry air than in 22 per cent. moisture in which there was no hatch whatever. Certainly since more hatched in dry air than in 22 per cent. moisture one can not claim that it was lack of moisture which prevented the hatch. Some other factor must have been at work and this factor was evidently the condition of the embryo.

The writer does not intend to convey the impression that moisture has no influence on the hatching of these eggs for, as Peterson indicates, it undoubtedly has but he wishes to point out the fact that in experiments of this kind the stage of embryonic development must be considered if accurate conclusions are to be drawn.

Thus the small percentage of hatch secured by Gillette in Colorado is explained by Peterson entirely on moisture conditions and yet the writer has just shown that the failure to hatch in some of Peterson's own experiments with *pomi* is due to an entirely different factor.

The hatching of the different species takes place in very much the same way although *prunifoliæ* is much earlier than *pomi* and *malifoliæ* which two hatch at approximately the same date.

After revolution of the embryo hatching can be advanced or retarded greatly by weather conditions. An elevated temperature which before this time is fatal serves afterwards to hasten hatching unless the atmosphere is extremely dry. The gelatinous matrix in which the egg is embedded has by this time become more or less brittle and splits irregularly, usually in a longitudinal direction. This is soon followed by a rupture in the shell made by the egg burster. The young nymph continues to push its way outward until it stands in an erect position just above the slit in the shell. At this time the membrane has not ruptured and the aphid sometimes dies without freeing itself. Normally, however, the membrane ruptures to the right of the egg burster and gradually works downward carrying this structure with it. The young insect then leaves the egg and this thin pellicle is left as a shrivelled structure partly protruding from the slit in the shell. In speaking of the fate of the egg burster Peterson (*l. c.*, p. 14) says: "During emergence this ridge disappears and only a faint line remains along the meson." As far as our observations go, however, the egg burster retains its identity as part of the membrane in much the same way as that of *Corydalus cornutus*, described by Riley. In some cases the writer has observed young of viviparous aphids to free themselves while on the leaf. Packard[3]

[2] New Jersey Agr. Exp. Sta. Bull. No. 332, 1919.

[3] "Text Book of Entomology," 1909, The Macmillan Co., p. 583.

has reported the casting of the amnion of *Melanopus spretus* while the nymph is free from the egg and mentions observing this condition in the hatching of several other insects. In fact, it has been observed that very many insects, including the seventeen year cicada, are entirely enclosed in this membrane after hatching.

In the aphids as the embryo revolves the serosa contracts and draws with it the cells of the polar organ and the serosa and polar organ from the dorsal plate. This then invaginates, forming the dorsal body which separates itself from the amnion completely and is ultimately absorbed. Thus only the serosa and polar organ disappear while the amnion closes the gap and remains as a distinct membrane over the embryo. This membrane separates, remains distinct, and, as previously indicated, is left behind as a thin, transparent membrane by the hatching nymph.

Headlee[4] has stated that "A third layer may be seen as the nymph hatches, but this is probably the first-cast skin of the nymph," and this view seems to be held also by Peterson (*l. c.*, p. 10) who says, "This layer is shed by the nymph as it emerges, consequently it must be an exuvium." The writer is unable to agree with this view for the exuvia cast by the nymph during its growth are quite different from this embryonic membrane which it leaves behind when hatching.

After the embryo has revolved and is proceeding toward hatching the egg is in much more critical condition than during the dormant period. It is less protected by reason of the fracture of the gelatinous matrix enclosing it and the embryo which is actively growing is more susceptible to the effect of spray solutions. This undoubtedly explains the varying results obtained by different workers in spraying experiments on aphid eggs. In many lots wherein the embryo had revolved good results were obtained, whereas in other lots where no revolution had taken place, hatching was about normal. In this connection it is important to bear in mind that *pomi* and *malifoliæ* revolve at about the same period, the middle of March in Washington, and that early in April these eggs are very susceptible to treatment with such sprays as lime sulphur. At the time these eggs are in this critical period of embryonic development those of *prunifoliæ* have hatched and the young are in the first or rarely the second instar. These young nymphs are not affected greatly by lime sulphur but are easily killed by nicotine sprays.

[4] New Jersey Agr. Exp. Sta. Bull. No. 328, 1918.

It seems clear therefore, than in interpreting hatching records of aphid eggs in the course of spraying or other experiments, account must be taken of the condition of the embryo in regard to revolution. Knowledge of this fact is also essential in practical control work. Thus in the case of the three apple aphids here considered, the recommendations for use of the combined lime-sulphur-nicotine spray as a "delayed dormant" treatment, is seen to be based on scientific reasons—the lime sulphur to destroy the later hatching eggs, principally *pomi* and *malifoliæ*, and the nicotine for the already hatched aphids.

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THE AMERICAN CHEMICAL SOCIETY

(Continued)

SECTION OF CELLULOSE CHEMISTRY

Harold Hibbert, *chairman.*
G. J. Esselen, Jr., *secretary.*

Effect of adding various chemicals to wood previous to distillation: L. F. Hawley. Several different chemicals have been mixed with wood and the mixture distilled for the determination of the effect of the chemical on the yield of valuable products. The chemical was mixed with the sawdust by sprinkling in case it was water soluble or by mixing the solid in case it was insoluble. The mixture was then briquetted and the briquets distilled in a special retort in which mechanical pressure could be applied to the briquets during distillation. The only chemical tried which had a beneficial effect when used in reasonable quantities was sodium carbonate. When about one per cent. of sodium carbonate is mixed with wood previous to distillation the yield of methyl alcohol

is increased by about 50 per cent. The yield of acetic acid is not decreased by the sodium carbonate.

The removal of free acid from nitrated cellulose, with special reference to the use of saline leaches: S. E. Sheppard.

Motor fuel from vegetation: T. A. Boyd. The use of motor vehicles in the United States has increased very much more rapidly than the production of crude oil and considerably faster than the production of gasoline, although the volatility of gasoline has beeen decreasing from year to year. This, coupled with the fact that reserves of crude oil are being rapidly depleted, makes it essential that other sources of motor fuel be developed. Alcohol makes a desirable motor fuel, and it appears to be the most promising ally to petroleum oils for the purpose. The preparation of sufficient alcohol for motor fuel from foodstuffs does not appear to be feasible, and it seems advisable to make a further and more intensive investigation of cellulose as a source of this material.

Possibilities of the moist tropics as a source of cellulose and carbohydrates: H. N. Whitford. The subject resolves itself into three headings, (*a*) an inventory of present resources of the tropics, (*b*) growth in moist tropical forests, (*c*) bamboo and other plants as sources for cellulose and industrial alcohol. (*a*) From an economic standpoint tropical forests are not so complex as usually believed. A rough estimate of the great forested regions of South America and Asiatic tropics shows more than twice as much standing timber as in the United States. (*b*) Actual knowledge of growth of certain forest crops shows that practically the annual increment per unit area as fully stocked stands is usually more than twice that in the United States. (*c*) Heavy yields of bamboo indicate that it may be the most promising plant for the production of cellulose and possibly alcohol. Nipa palm possesses possibilities for alcohol.

The possibilities of a future fuel supply from our forests: R. C. Hawley.

The rôle of the chemist in relation to our future fuel supply: Harold Hibbert. Up to the present attention has been concentrated primarily on the production of alcohol from cellulose products. In view of the fact that in the fermentation of sugar not more than 80 per cent. of the theoretical quantity of alcohol is obtained while 50 per cent. by weight of the original material is lost in the form of carbon dioxide, it seems desirable to subject cellulose to intensive investigation with a view to ascertaining how far it is possible to convert it into other materials such as furfuraldehyde, etc., in which a better yield could possibly be obtained of a material suitable for use as a liquid fuel.

The effect of chemical reagents on the microstructure of wood: Allen Abrams. A method has been devised for treating very thin sections of wood with chemical reagents under different conditions of temperature and pressure. This method has been used in treating sections with a considerable variety of reagents, such as cellulose solvents, acids, alkalies, oxidants and chemicals used in paper-making. The effects on the microstructure of wood have been studied both by microscopic observation and by cell measurements. Some of these effects may be summarized as follows: (1) Cellulose solvents act strongly and proportionately on both the middle lamella and the cell wall. (2) Strong oxidants act on the cell wall but have little effect on the middle lamella. (3) The ordinary paper-making reagents act strongly on the middle lamella, with but relatively little visible effect on the cell wall. Whereas caustic soda solutions cause swelling of the cell wall, solutions of sodium bisulphite and sodium sulfide cause little or no swelling.

Measuring soil toxicity, acidity and basicity (coöperative work with the U. S. Dept. of Cereal Investigation): R. H. Carr. There is a close connection between an acid soil, the amount of easily soluble iron and aluminum present, and the soil's capacity to grow a good crop. A quantitative method has been developed to measure the presence of easily available iron and aluminum by extracting the dry soil with an alcoholic solution of potassium thiocyanate. A red color will develop if the soil is acid, due to the formation of ferric thiocyanate. This solution is titrated with a standard alcoholic base until the color just disappears. If no color develops the soil is neutral or basic and it may be titrated with a standard alcoholic acid, and the limestone equivalent determined. A special tube has been devised for this work.

Influence of mixed acid on the character of nitrocellulose: W. J. Waite. The vapor tension of nitric acid in the nitrating bath controls the degree of nitration of the nitrocellulose. The dehydrating value of sulphuric acid is a factor which

influences the vapor tension of the nitric acid. The hydrolyzing action of sulphuric acid in the nitrating bath sets up secondary reactions, which are responsible for variations in yield, formation of insoluble bodies, gelatinous products, and unstable esters. The solubility of nitrocellulose is determined by the dehydrating value of sulphuric acid in the nitrating bath. The nitrocelluloses used in the commercial world are divided into seven types based on their specific uses. Degree of nitration curves based on factory experience, showing the degree of nitration as a function of the actual nitric acid and the nitrating bath, indicates that, for the same degree of nitration, as the actual nitric increases a corresponding increase in the nitrating total is required in order to maintain the same molecular ratio between the water and sulphuric acid in the bath.

Some commercial possibilities of corn cob cellulose: F. B. LAFORGE. Brief outline of our process for the preparation of adhesive, furfural and cellulose from corn cobs; proposed uses of the three products. Preparation of corn cob cellulose in powder form and uses as substitute for wood flour for nitration and acetylation; preparation in the form of pulp and uses in paper manufacture. Corn stalks and husks as a source of adhesive furfural and fiber.

A color test for "remade milk": OSCAR L. EVENSON. A yellow color produced by the action of sodium hydroxide on the washed curd of milk made from milk powder, serves as a test for the presence of milk powder in natural milk. The curd precipitated from 25 c.c. of milk with acetic acid is washed and placed in a vial with 10 c.c. of 5 per cent. sodium hydroxide. Natural pasteurized milk treated in the same manner is used as a control. The color is probably due to the presence in the curd of a residue of aldehydic nature resulting from the action of heat and desiccation.

Nitro-cellulose and its solutions as applied to the manufacture of artificial leather: W. K. TUCKER. (1) Properties of the nitro-cellulose: (*a*) Degree of nitration and why lower and higher nitrations are objectionable; (*b*) viscosity; (*c*) degree of purification and the effects of the purification on viscosity; (*d*) stability; (*e*) ash. (2) Solution: (*a*) solvents and non-solvents generally used and why; (*b*) viscosity of solutions generally used. Granular and short solutions; (*c*) effect of various solvents and non-solvents on the viscosity of solutions; (*d*) proportion of nitro-cellulose in solutions generally used and short discussion of the use of solution with a larger percentage.

An experimental study of the significance of "lignin" color reactions: ERNEST C. CROKER. An investigation of the so-called color reactions showed that the following phenols gave strong red, violet or blue colors with wood of any kind when applied in strongly acid solution: phloroglucinol, orcinol, resorcinol, and pyrogallol. Likewise, all primary aromatic amines gave yellow to orange colors when applied in acid solutions of any strength. The secondary amine, diphenylamine, also gave an orange color even when highly purified and freed from traces of primary amines. Pyrrole gave a deep red color in hydrochloric acid solution. Various materials were substituted for wood, and tested with above types of reagents for color formation. It was found that only (but not all) *aromatic aldehydes* gave color reactions similar to those given by wood. Spectroscopic investigation and comparison of colors obtained showed that the principal color source of wood is not vanillin or furfural, as several writers have claimed, but a different aldehyde—possibly coniferyl aldehyde. It was found that certain natural phenols and ethers such as eugenol and safrol, which are reported as giving colors with the phenols and aldehydes, do so only because of aldehydic impurities. The Mäule test was found to give a distinct red color only in the case of deciduous woods. The test was found to be caused by a component of the wood, which after chlorination turns red when made alkaline. Apparently no color test is an indicator of *lignin,* but of traces of materials (aldehydic for most of the tests) which usually—perhaps always—accompany lignin.

A proposal for a standard cellulose to be available for research: B. JOHNSEN.

A discussion of some beater furnish reactions from the standpoint of colloidal chemistry: JESSIE E. MINOR. This discussion is based upon a series of experiments performed for the purpose of obtaining some more exact information as to the changes in the physical properties of a paper which are brought about by each addition made to the furnish. The increased strength attained by beating is due to the mucilaginous product of hydrolysis and the decrease in strength by excessive beating is due to the loss of fiber structure. Alum coats the fiber with a gelatinous layer of aluminum hydroxide and changes the electrical charge on the fiber. It thus aids in size retention as does calcium sulphate, though the latter is less effective. In-

soluble fillers which give almost no ions are still less effective. Their chief effect is to weaken the paper as do calcium chloride and sodium carbonate. Explanations for these various phenomena are given based on the modern concepts of colloid chemistry.

The solubility of cellulose acetate in chlorinated hydrocarbons: Gustavus J. Esselen, Jr. The present paper offers an explanation of the fact that cellulose acetate is soluble in certain chlorinated hydrocarbons but not in others, as for example, in chloroform but not in carbon tetrachloride. The internal pressures of the chlorinated derivatives of methane and ethane have been calculated and it is shown that the corresponding solvent action on cellulose acetate is in general what is to be expected from the relative values of the internal pressures. The fact that the addition of a little alcohol increases the solvent action of certain of the solvents in question is also shown to be in accord with what is to be expected from the accompanying change in the polar environment.

The action of dry hydrobromic acid on cellulose and related derivatives: Harold Hibbert and Harold S. Hill. The authors have reinvestigated the action of dry hydrobromic acid in chloroform solution on cellulose, viscose, dextrose, α methyl glucoside, sucrose and certain other derivatives. Higher yields of brom-methyl furfuraldehyde were obtained in the case of cellulose and viscose, while with dextrose as much as 12–15 per cent. of the crystalline product was obtained. Good yields were also obtained in the case of α methyl glucoside and other derivatives. The evidence would seem to prove that the formation of brom-methyl furfuraldehyde is no longer to be associated with the presence of a free carbonyl (keto) group in the cellulose molecule.

The oxidation of cellulose: W. S. Holzberger.

European practise in cellulose acetate and dopes during the war: Philip Drinker. (1) Cellulose acetate developments from commercial and scientific aspects. (2) Cellulose acetate solvents, non-solvents, plastics, high-boilers, etc., as developed for airplane dopes. (3) Various dope formulæ as shown by their historical development as the war progressed, the "standard forms" ultimately decided upon, etc. (4) The effect of sunlight and other agents on fabrics and means of preventing said effects with account of researches on these subjects. (5) Recovery of solvents in doping and recovery of cellulose acetate from discarded airplane fabrics.

The influence of temperature on hemi-cellulose production: W. E. Tottingham. Red clover and buckwheat plants grown at temperatures of about 15° to 18° in one case and 20° to 23° in another, in the latter case with the evaporating power of the air kept nearly the same for the two temperature ranges, have shown an increase of acid hydrolyzable material at the lower temperatures. This difference amounted to about 5 per cent. of the total dry tissue of the plant. No evidence has been obtained as yet of definite variations of the fundamental cellulose with temperature differences attending growth. It appears that the hemicellulose which would be included in the acid hydrolyzable material may form an important carbohydrate reserve in the plant economy. It is suggested that the depression of respiration in proportion to photo-synthesis at the lower temperatures may favor the accumulations of hemi-cellulose observed.

The chemical changes involved during infection and decay of wood and wood pulp: Mark W. Bray and Joseph A. Staidl. The results and significance of the determination of various constants are given on a number of samples of sound and decayed spruce woods, pulps and waterleaf papers made from them by the groundwood, sulphite and soda processes. It was found that the water soluble materials, the alkali soluble substances, the copper numbers, and the beta cellulose, increase, while the alpha and gamma cellulose constants decrease with the progress of decay, in all the woods, pulps, and papers studied. The lignin content shows an apparent percentage increase in decayed wood. If the calculations are based on the original weights of the sound wood, however, there is a slight decrease in this constant. The data given show the relation of the lignin or non-cellulose encrusting material of sound and decayed woods and pulps. Certain organisms of decay have a selective action on the constitutents of wood and wood pulp, attacking the cellulose in preference to the non-cellulose encrusting substances. Gamma cellulose is so unstable that a very small percentage was obtained in decayed woods and pulps. The losses sustained by the paper industry as a result of the use of decayed woods and pulps are pointed out.

The chemical constitution of soda and sulfite pulps from coniferous woods and their bleaching qualities: Sidney D. Wells.

Charles L. Parsons,
Secretary

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SOME PRESENT ASPECTS OF CHEMISTRY IN THE UNITED STATES[1]

It has often been observed that those living in the midst of great events sometimes fail to understand the far-reaching effects of the occurrences going on around them. During revolutionary times attention is so riveted upon the single occurrences which follow each other with bewildering rapidity that the participants often fail to view the succession of events as a whole and thus miss their full significance. Revolution is scarcely too strong a word to apply to the changes relating to chemistry which are taking place in this country. The very great impetus which the science of chemistry has experienced during recent years brings with it a series of problems vitally related to the science as a whole, to our educational institutions and to industry.

It seems appropriate that on this occasion we might with profit, to borrow a business expression, take stock of the present situation. I shall therefore endeavor to give a brief and partial analysis of the outstanding features of the existing conditions, which are more or less confused, and lay down a few broad principles which appear to offer a sound basis of future development.

The events of the past five years have exerted a profound influence not only upon chemistry but upon various other sciences represented by the American Association for the Advancement of Science. To meet the critical situation presented in 1914 and the more critical condition in 1917, the country called to its service the entire scientific resources at its command and nearly every branch of science contributed something, either directly or indirectly, to aid in the solution of the pressing problems presented. The geologist was called

[1] Address of the vice-president and chairman of Section C, of the American Association for the Advancement of Science, Chicago, December, 1920.

upon to reexplore the natural resources of the country and to find, if possible, within our own borders raw materials which we had formerly imported, and many important and unexpected discoveries were made. The physicist was presented with a host of problems, problems in light, in sound, in electricity, in wireless transmission, etc., and in the attempt to solve these problems contributed materially to the advancement of our cause and to the general welfare. The engineer, working in conjunction with the physicist and chemist, gave body and substance to the discoveries of the latter, and gave besides an example of the power of concentrated and intelligent effort to solve engineering difficulties of all kinds, which won the admiration of the world. The various branches of medical science, represented by the physician, the surgeon, the physiologist, the pharmacologist and others, all rendered a service of inestimable value, the memory of which will long be enshrined in the thought of the world. I refer not only to the direct service in mitigating immediate human suffering, but also, and more important even than that, to the advances in medical science which were made. And so we might call the roll of the sciences and each could respond with a record of achievement, of things actually accomplished for the welfare of our country and the world.

It is perhaps true that no branch of science was given the opportunity of rendering more conspicuous or more vital service than that of chemistry. It is scarcely too much to say that for a period of two years the whole orderly course of scientific research in chemistry was suspended. In 1917 the country was confronted with a very large number of practical chemical problems, some of them of an extremely complex and difficult nature, the prompt solution of which was imperatively demanded. These problems may be grouped under two general heads. Since foreign sources were to a large extent cut off as early as 1914, we were faced with the task of supplying the ordinary everyday needs of the community for the vast number of substances in the manufacture of which chemistry played an essential part, and these problems were far from being satisfactorily solved in 1917. The second group included the multitudinous problems which had to do directly with the prosecution of war. In order to meet the situation thus presented the critical nature of which could hardly be exaggerated, practically the entire research and manufacturing facilities of the country were drafted. The extent to which the research personnel of the country was drawn into some branch of industrial or war work was truly amazing. Never before had this country witnessed such intensive chemical effort. For the industrial chemist it did not as a rule call for any very radical change in the nature of his work. To him it meant, in the main, redoubled effort in the line he was accustomed to, or in related lines. But for the large number of university men who were able to give a portion or all their time, the change was more radical. In many cases they abandoned, for the time being, the researches upon which they were engaged and addressed themselves to the solution of certain definite problems, not chosen by themselves, but presented by the exigencies of war. These men came from various colleges and universities in all sections of the country and for nearly two years gave themselves over to an entirely new experience, viz., an intensive study of definite problems which were essentially industrial in nature, in that they were in most cases directed toward ultimate large scale operation. After working out a particular problem in the laboratory it then became necessary, with the cooperation of the engineer, to put the process being developed through the various stages leading finally to large scale production.

The very great chemical activity which characterized this period and particularly the conspicuous success which was attained by the chemist in the solution of many of the difficult problems presented to him have had important results in several directions.

1. The chemist finds himself in a more favorable position than he formerly held in the eyes of the general public. It was not so very long ago that to the average man in the street,

the terms chemist and drug-clerk were synonymous. The educated non-technical man however was better informed. Asked for a definition of a chemist, he would reply, Oh! he is a curious fellow who can look at a rock and tell you what it is made up of! When one considers the fundamental importance of the work of the chemist to the everyday life of every individual in the community, that his work enters into everything he wears, eats, drinks, reads, works with and plays with, it is really astonishing that the public at large has had so little appreciation of him. It must be remembered, however, that in the past few opportunities were afforded to the average citizen, and no encouragement, to learn what the chemist meant to him. It was not so very long ago that the most widely disseminated chemical information was that furnished by the Sunday supplements of certain newspapers. And it will be recalled that they appeared to be particularly fond of describing such experiments as the extraction of gold from sea water, and others of a similar type, generally giving a more or less grotesque idea of the chemist and his work.

The education of the public as to the importance of chemistry to the community began in the fall of 1914 when it suddenly discovered that it was dependent upon other countries for many things chemical which were necessary to its daily comfort and convenience. And the temporary lack of things to which all were accustomed, and for which they were told to wait upon the chemist, did much to raise the latter in the public estimation. And when the promised articles began gradually to appear, in increasing quantity and with steadily improving quality, the chemist was still further raised in public esteem.

The second lesson came with the war. The ordinary citizen came to realize, as he had never done before, that in modern warfare the most powerful weapons of offense and the most effective means of defense are literally the products of the laboratories of scientists. Thanks to the introduction of what came to be known as chemical warfare, the late war became to a very large degree a contest between the chemists of the opposing countries. And a vivid knowledge of this fact was brought home to the people in a variety of ways.

Recoginzing the fact that, under a republican form of government, the widest possible dissemination of popular but exact information concerning a particular science is a matter of fundamental importance to that science, the American Chemical Society several years ago authorized and provided for the establishment and maintenance of an official news service, known as the American Chemical Society News Service. The chief function of this service is to furnish, at frequent intervals, to all the important newspapers throughout the country for publication, short popular articles on chemical subjects. The space given by the newspapers to these articles, while not all that might be desired, is gratifying in that it evidences an interest, and let us hope it will prove an increasing interest, on the part of the people generally in a subject which is of such great importance to the general welfare.

2. A second and very much more important change which has been taking place during the past five years is a growing appreciation of the value of research on the part of those concerned with chemical industry. Some of the larger and more progressive concerns, whose policies are dominated by men of scientific training, have long followed a liberal policy in regard to research. They have been sufficiently far sighted to recognize the possibilities of research in the utilization of by-products, the development of new processes and the improvement of old ones. Their experience has amply justified the financial wisdom of such a policy. A larger number of concerns have maintained research departments of a more limited scope, their activities being confined to the more immediate and obvious problems of plant operation. Then we have had a very considerable number of chemical plants in which no research chemists at all were employed. There has been in the past a surprising number of plants which were operated, in effect, upon the idea that

it would not be profitable to try to discover anything new about the chemistry of the processes being carried on.

Very rapid changes have been taking place in this respect during the past few years. The demand for research chemists in the industries has been stimulated by a variety of causes: the desire, in many cases at the instance of government, to increase output and extend operations into new lines, the stimulus to new enterprises afforded by the general shortage of chemicals, and, perhaps most important of all, the conspicuous success which has attended the efforts to solve various important and difficult chemical problems. It is worthy of note in this connection that in a number of instances discoveries of very great practical importance to industry have been made by university professors to whom contact with industrial chemistry brought about by war conditions was an entirely new experience.

Whatever other influences may have contributed, the result is that the industries are calling more insistently and for greater numbers of thoroughly trained and experienced research chemists than ever before and in consequence the universities and colleges of the country, along with other research institutions, are confronted with several very serious problems. In the main the Ph.D. graduates in chemistry, after completing their training, go into one of three lines of work. Some of them go into college teaching and in the past this field has absorbed a very considerable proportion of them. Others whose liking for pure research has been the determining factor in their choice have gone either into government service or to research institutions, educational and others. This choice has usually entailed being content, at least for a period of years, with a smaller financial return for their work than might have been expected in other fields. The remainder have gone into industrial work. As a result of the rapidly increasing proportion going into the last named field, the colleges particularly are finding it difficult and, in many cases, impossible to secure the services of properly trained men. Those connected with graduate institutions which are the source from which the colleges draw their teachers are in the best position to appreciate how serious the present condition is. Many times during the past twelve months the chemical department of the Johns Hopkins University has been compelled to reply to urgent calls for teachers that there were no men available. The seriousness of the situation is accentuated by the fact that, not only do the industries want the best and most promising men, but they are willing to pay larger salaries than the colleges and universities, with their limited endowments, can hope to pay and larger also than those obtaining in government research laboratories. The inducements offered by the industries are in fact frequently attractive enough to win over men all whose inclination is toward teaching and pure research.

There is another phase of the situation which is equally serious. Not only are the industries absorbing an undue proportion of young graduates, so much so that the universities and colleges find it impossible properly to fill various teaching and research positions, but in a good many cases they have invaded the research faculties in the universities themselves. To the university teacher the temptation to enter the industrial field is made very great by reason of the difficult economic situation in which he finds himself. The moderate increases in salary which have been recently granted by most of the institutions of the country have been entirely insufficient to offset the decreased purchasing power of the dollar and the economic position of the teacher, never particularly enviable, has been for the past three years considerably worse than formerly. The temptation to improve their economic positions has induced a number of men to abandon their university careers for industrial work, with consequent crippling of the research work of the institutions concerned. A perhaps larger number of university professors of chemistry have adopted a compromise. To supplement an inadequate income they have been devoting their summer vacations to industrial work, and in many

cases acting in an advisory capacity to their employers while they are carrying on their regular university work. The perils in such a situation from the standpoint of the university and the cause of pure science, some of them obvious and others not apparent, have been discussed several times and will be referred to a little later.

We come now to the consideration of another phase of the present situation. An active discussion has been going on for several years having to do with the general subject of the relation of the universities to the community. The particular part of this discussion with which we are concerned is that pertaining to the relation of the departments of chemistry in the university to the chemical industries.

However much some of us may be inclined to cling to our old ideals, I think most of us will agree that the idea long held of the university as a seat of learning for learning's sake is gradually giving place to a new conception of the university as a utilitarian institution. To appreciate the change that has already taken place one need only visit the class rooms of any large institution and see the handful of students taking Greek, for example, while in any subject having a direct practical utility, huge lecture rooms are filled to overflowing. Many colleges and universities have endeavored to uphold the old ideals and have continued to maintain the old chairs, and a few students continue to take these so-called cultural courses and always will so long as they are offered, but it remains true that the great majority of the students are interested mainly in those subjects which have a definite practical value. This is true of both graduate and undergraduate schools. And of necessity the departments dealing with subjects which are of practical value to the student in after life are receiving relatively greater, and increasingly greater, financial support from governing boards. Thus our higher institutions of learning, and particularly the graduate departments, are apparently tending to become, in fact, professional schools; that is, institutions in which men and women receive specialized training which fits them for a particular kind of work. This development is perhaps not so much the result of the adoption of a definite policy by those in charge of such institutions, but rather comes from the demand on the part of the students themselves. The students want such courses and, if a particular university will not give them, they will go elsewhere. The very great popularity of chemistry in the colleges and universities throughout the country is not due to a widespread scholarly interest in the science itself, but arises from the facts that chemistry is fundamentally related to the welfare of the community and that a thorough knowledge of the subject opens the door to an attractive profession.

We have already pointed out that most of the graduate students in chemistry in the universities may be grouped under three heads:

1. Those looking forward to professorships of chemistry in colleges, in which their chief work will be the teaching of chemistry to undegraduates, with limited opportunities for research.

2. Those looking forward to careers of research in pure chemistry, either in universities or other research institutions.

3. Those expecting to become industrial chemists.

So long as the university had to do mainly with students of the first two groups, there was no particular difficulty in providing suitable instruction for them without in any way endangering the ideals of the university laboratory as a place set apart from commercial considerations and devoted, with singleness of eye, to the cause of the advancement of science for the common good. The course of instruction generally adopted by American universities required for its completion three or more years' work subsequent to the bachelor's degree. A part of this time was devoted by the student to acquiring a knowledge of the fundamental facts and principles of the science, after which he was required to spend one or more years in actual research under guidance.

The rapid increase in the number of stu-

dents falling under group 3, that is, those who come to the university with the idea of going into industry, raises, in addition to those problems already referred to, a number of others of equally vital importance to the universities and to the industries themselves.

1. Unless all signs fail, the demand for chemists for the industries is not a temporary one, but will continue and in all probability increase. The country has definitely set out to develop its chemical industries, the goal sought being nothing less than chemical independence. The realization, even if it is not altogether complete, or falls short of our present hopes, will call for a continuous supply of chemists. The enhanced popular interest in the subject may also be expected to produce an increased demand for chemists in college and university positions. It seems certain therefore that the graduate departments of chemistry (and undergraduate as well), already in many cases among the largest in their respective institutions, must look forward to a considerable increase in the number of students applying for instruction each year. This will entail problems of enlargement of buildings and other additions to material equipment, increase of teaching personnel, possible additions of new courses, etc. But these are questions which mainly concern boards of trustees and I will not discuss them here.

2. A group of problems are presented having to do with the content of the courses offered for graduate students. The graduate courses that have been given in the past were developed along broad theoretical lines without particular reference to the training of men for the industrial field. The attempt was made to give the student as broad an acquaintance as possible with the basic facts and principles of the science of chemistry and in addition a knowledge and experience of the methods of research.

Now, inasmuch as the industries are dependent upon the universities for the training of the chemists which they require each year in increasing numbers, it is only natural that they should concern themselves with the character of instruction given. And inasmuch as one of the functions of the university is to train men for the industrial field it is only proper that those charged with the responsibility of this training should inquire whether or not the students are receiving the kind of instruction and experience that best fits them for their future work. The question therefore whether the chemical departments of the universities are giving the best kind of training to those who are to go into industrial work is entirely proper and the correct answer is of vital importance to the university, to the science of chemistry and to chemical industry.

Now there are a number of people among both teachers and employers of chemists, who believe that the present methods of university instruction could be materially changed to advantage so far as the future work of the industrial chemist and chemical industry are concerned and various suggestions have been put forward, most of them with the idea of making the work more "practical" in character. It is said that the present method and scope of university teaching make the Ph.D. graduate too theoretical and impractical; that when he goes into the plant he is at a loss because he has learned to think only in terms of small scale reactions and because he has no knowledge of engineering and therefore no appreciation of the mechanical difficulties that always appear when you go from the laboratory to large scale production. Hence it is concluded that the kind of chemist the industries need is one who is also an engineer. Hence the growth of a large number of institutions in the country in which a high-school graduate is put through a training embracing four or five years, taking various courses in mathematics, physics, engineering and chemistry, is given a bachelor's degree and sent into the industry. However valuable in a chemical plant men of this training may be, their outlook upon chemistry as a whole is entirely too limited to make them of any great value in the research laboratory. If our country is to realize its dream of chemical independence, our industries must have available and must employ large numbers of chemists of the highest quality, characterized by breadth

of chemical training, familiarity with chemical literature, enthusiasm for research and, above all, a thorough understanding of theoretical principles, which alone gives the investigator the ability to interpret observations and devise sound and effective methods of attack. The above qualities are essential to the research chemist, regardless of whether he is in an industrial or a university laboratory. For in the development of an industrial process, the first stage is in the laboratory and here the problem differs from a problem in "pure" research only in one particular, viz., that it is directed toward a definite commercial object. The same thoroughness should be sought, the same methods employed and precisely the same qualities on the part of the investigator are necessary.

Those of us therefore who are charged with the responsibility of university instruction in graduate chemistry should set our faces against the tendency in evidence around us to place the emphasis in teaching upon the practical, necessarily at the expense of the fundamentals.

This does not in any sense mean that university laboratories should avoid attacking problems the solution of which is of importance to industry. On the contrary, one of the happy developments of the past few years has grown out of the opportunity which has been afforded to large numbers of university professors to get in close contact with some of the problems of commercial chemistry. Many of these problems, of fundamental and far reaching importance to the industries, have been taken into the university laboratory and the professor brings to their study his ripe knowledge and experience, his patience and resourcefulness which, combined with the material facilities at his command, offer the promise of sure progress in their solution. Already substantial contributions along a number of lines have been made and we may confidently look forward to greater achievements in the future. The universities may very properly take advantage of the opportunities thus presented to render a high service to the community. But there are also dangers inherent in the situation. While rendering this service, we must sedulously avoid sacrificing the ideals of pure science. We must keep out of our university laboratories the spirit of commercialism and not allow our interest in these problems of applied chemistry to lessen our interest in the large number of even more fundamental questions which happen to be of less immediate practical importance.

In the foregoing discussion we have partly anticipated the answer to a question which has been frequently discussed in recent years. I refer to the matter of cooperation between the universities and the industries. How can the university laboratory render the most valuable service to chemical industry? How can industry cooperate with the university to the end that the interests of both may be best served? It must be clear that these interests are mutual; more particularly, that any plan which enables the university more effectively to perform its function of advancing scientific knowledge and training chemists will be beneficial to industry and anything which interferes with or in any way hampers the university laboratory in the performance of these primary functions must ultimately be harmful to industry.

Recognizing the importance of this question and fully conscious of the wisdom of properly guiding the movement already under way looking toward a closer relation between the universities and the industries, the American Chemical Society, under the recent presidency of Dr. Stieglitz, authorized the appointment of a committee to study and report upon the subject. The committee consists of leading educators and representatives of industry and I believe is still engaged in studying the question in the effort to formulate a plan by which the desired ends may be accomplished without injury to the university.

The opening paragraph of a tentative report made by the committee reads as follows:

> The most important contribution which the universities can make to the development of industry in this country is to supply the industries with sufficient numbers of men thoroughly and

broadly trained in the principles of chemistry. All other considerations must be subservient to this fundamental purpose.

This is a thoroughly sound principle and if it is accepted fully and made a guiding policy by both the university faculties and the industries it will constitute a touchstone by means of which the quality of any specific proposal may be tested. It must be clearly understood that if men are to be "thoroughly and broadly trained in the principles of chemistry" emphasis must be laid upon a good many things of which we can not *at present* point out any very direct practical application to industry. The fact is, however, that the number of these abstract questions emphasized by university teachers that have no bearing upon the problems of commercial chemistry is not nearly so large as the practical man believes. In other words, chemical industry lags considerably behind chemical science. The discovery on the part of industry that it has not been utilizing the chemical knowledge which has been available all along, carefully recorded in the literature, is really one of the outstanding events of the last five years. This is the explanation of the greatly increased demand for trained chemists. Their chief efforts will be directed, not so much toward original research, but rather toward applying what is already recorded to the practical problems of the plant.

The second paragraph of the report deals with "the strong tendency at the present to draw men, who have been particularly effective in research work, away from the universities by the payment of salaries far in excess of the salaries paid the same men in a university." In view of the considerable number of younger men of great promise who have in consequence been induced to abandon their university careers, the report goes on to say that "it seems evident that unless a very considerable increase in the salaries of teachers of chemistry can be secured, the next generation of chemists is likely to be trained by a set of mediocre men. Such a result would be disastrous to our industries and every possible effort should be made to meet this danger."

As to the various specific proposals for cooperation that have been put forward they should all be tested by the touchstone mentioned, and if this is conscientiously done it seems to me that no very great difficulty will be experienced in reaching wise decisions. There would seem to be no possible objection to the endowment of fellowships in the universities, similar to the duPont fellowships, which leave the student and the instructor entirely free in the choice of the subject of research and which carry no restrictions in the matter of publication of the results.

Fellowships designed to promote the solution of problems for the benefit of a particular industry, it seems to me, may be safely accepted by the university, but it should be clearly understood: (1) That the subject of investigation should be of fundamental importance to the industry as a whole; (2) that the instructor and student must be left entirely free in deciding upon the method and scope of the investigation; (3) that there must be no secrecy attached to the work; and (4) that the results should be published for the benefit of the industry as a whole within a reasonable time.

It seems to me that other kinds of fellowships proposed, of a private character, for example, a fellowship endowed by a single firm for its exclusive use, either for a limited or indefinite period, would be attended with grave dangers to the university. Aside from other considerations of equally vital importance, one of the most invaluable and inspiring features of the university research laboratory, viz., the entire freedom from restrictions which prevails, would be lost by the introduction of a system of private fellowships. Each worker, while he is interested mainly in his own particular subject, needs the inspiration which comes from contact with his fellow workers, and to deny him the privilege of learning what those around him are doing is to take from him a thing of inestimable value and for which there is no substitute.

B. F. Lovelace

The Johns Hopkins University

AN ANCIENT SKELETON DISCOVERED IN ECUADOR

DURING the month of May, while engaged in archeological work on the Ecuadorian coast, for the Museum of the American Indian Heye Foundation, the writer discovered, *in situ,* a complete human skeleton under conditions which indicate considerable antiquity. The find was made in the province of Esmeraldas, along the beach at a place 40 miles north of the equator called Tomsupa. This was the writer's third visit to the site, which he discovered in 1907. A brief account was published in his paper, "Archeological research on the coast of Esmeraldas, Ecuador," in the proceedings of the XVI. Internationalien Amerikanisten-Kongresses, Wien, 1909. In this paper attention was called to the character of the deposits, accompanied by a photograph of the same.

The skeleton recently uncovered was found in the bank a few hundred yards north of the place shown in the photograph, at a point where the alluvium is considerably deeper. All along the beach in the vicinity for some distance one finds deposits of human artifacts in the bank.

The region here is a plain bounded on the north by low hills which terminate at the sea in a point called Punta Chevele. To the south just below where the Atacames River empties into the sea there are also hills, and at the ocean is a rocky point called Punta Sua. From appearances it would seem that this plain, three or four miles wide, was formerly the dwelling place of numerous people, as we not only find here the Tomsupa deposits, but they are even more extensive at the southern limit along the banks of the Atacames River, and they also extend inland for some distance. It would seem that this plain later became the course of a great river, which gradually deposited gravel and alluvium to a depth of fifteen feet. Then came a washing away of the alluvium, more extensive to the south, as at present more than half of the plain along the beach is only slightly above high water mark.

In the paper above referred to are the following data about the Tomsupa deposits:

> The layer of pottery along the beach varies from 20 to 24 inches, and the measurements are as follows: alluvium and light earth, 16 inches; dark soil, ashes containing pottery and shells, 2 feet; sand to present line of beach, 1 foot.

At other places during our last trip deposits were found covered with 3 feet, and even 5 feet of alluvium. Skeletal remains were discovered nearby at a depth of 4 feet 7 inches under undisturbed alluvium.

Near the northern extremity of the plain is a ridge of alluvium running at right angles to the beach, which abruptly terminates at the north toward Punta Chevele, and from here on to the point the same conditions prevail as at Atacames, the plain being only slightly above high water mark. In this alluvial ridge there is a layer of stratified coarse gravel 12 feet from the surface, and this deposit extends southward for several hundred yards terminating with a covering of alluvium of three or four feet. This gravel deposit averages 2½ feet in thickness.

The skeleton to which attention is called in this communication was discovered at the deepest part of the ridge and under the gravel, being covered by 12 feet of alluvium, and 2½ feet of gravel. It was discovered by the writer's assistant, his son, Winthrop L. Saville, whose attention was drawn to a reddish knob just visible under the undisturbed gravel and alluvium. After the writer and his assistant excavated for a few minutes it was found to be a human leg bone. As night was coming on, a photograph was taken of the locality; the remains were carefully covered to protect them from rain and the carelessness of passers-by, for in this part of Ecuador the beach is the only highway. The next day the excavation was continued with some difficulty due to the extreme fragility of the bones and the nature of the high bank above, for the writer had far too little time at his disposal to permit of first cutting down the bank, and no laborers could be obtained at this place. We finally uncovered the remains of a young man just cutting his wisdom teeth. He had been buried

with the arms and legs bent close to the body, and the skull had been deformed with the frontal depression. The entire skeleton was tinged a bright red by the infiltration of iron, and the inner surface of the skull was covered by a deposit of brownish-black limonite. We were able to take out the skull, which fell into a hundred pieces, and only fragments of the bones. The only relic found was the foot of a pottery vessel with traces of a highly polished red inner surface. This was found near the skeleton above the bones and under the gravel. The skeleton was covered with earth, immediately below the layer of gravel and alluvium, and was not intrusive, there being absolutely no signs of disturbance above. It could not have been intruded from the side as there is rapid erosion going on here. Every year parts of the banks are washed away by the sea during the time of flood tides. The owner of the property assured the writer that the bank now visible is not the surface seen during former visits, as the ocean is slowly washing away the shoreline.

Concerning the age of this skeleton, the archeologist is not competent to pass his opinion. This must be done by the geologist and physiographer. But the writer is of the opinion that this find is the oldest burial thus far found in South America.

Marshall H. Saville

SCIENTIFIC EVENTS

THE MULFORD BIOLOGICAL EXPLORATION OF THE AMAZON BASIN

Further advices received from Dr. H. H. Rusby, director of the Mulford Biological Exploration, report continued favorable progress, and a considerable amount of scientific work already accomplished in quest for medicinal plants and biological specimens.

Members of the expedition left La Paz, Bolivia, about July 9, whence they proceeded by rail to Eucalyptus, the terminus of the railroad. From Eucalyptus to Pongo they traveled by auto truck over the new auto road recently completed by the Guggenheim interests in Bolivia. From Pongo, a three days' journey by mule brought them to Canamina, which will be their temporary headquarters for three or four weeks. From this point certain members of the party will make an ascent of the La Paz river for a considerable distance for the purpose of making special collections, the remainder of the party making detailed studies in the vicinity of Canamina.

Collections have been made in and around Mollendo, Arica, Arequipa, Tiavaya and La Paz. A large quantity of these materials, shipped just before the party left La Paz, has been received in Philadelphia.

The shipment includes among other things botanical specimens of economic products of Peru and Bolivia, such as the green-colored, purple-striped fruit of the "pepino"; the fruit of a species of *Tasconia* which is sold in the markets there under the name of "Tumbo"; also another edible fruit known as "acchocta," and a turnip-shaped root called "rhacache," and many others. These will go to the economic museum of the New York Botanical Garden and the Brooklyn Botanical Garden. A quantity of herbs is also included, which will be sent to Professor Edward Kremers of the University of Wisconsin, who will study the volatile oils contained in them.

In ascending and crossing the mountains from Mollendo to La Paz, Drs. Rusby and Hoffman made systematic observations on blood pressure changes at different altitudes and on the mountain sickness known as "sirroche." They have availed themselves of every opportunity to study tropical diseases and while at Arequipa they visited the fine hospital there to study a form of tropical ulcer known as "uta."

EDUCATIONAL FORESTRY

(*From a correspondent*)

Educational forestry is being carried on by experts at the Alleghany State Park, the new public recreation ground just dedicated in Cattaraugus county. The Buffalo Academy of Science is cooperating with the New York State College of Forestry in this work.

Henry R. Francis, professor of forest

recreation, and R. R. Fenska, professor of forest engineering, both of the forestry college, who are engaged in making a survey of the 65,000 acres of forested land contained in the tract, will lecture to visitors every Saturday in the Academy building at Tunesassa.

The talks will include a personally conducted hike through the forests and a study of the flora and fauna encountered on the trip. Valuable information about birds, woods and wild animals common to that section of the state will be given by the experts, something that every person who goes into the woods should know. The hike will be followed by an illustrated talk on forestry, particularly as the subject pertains to the best use of the woods for recreation and health. The lectures will be given every Saturday until the vacation season ends.

The efforts of the commission headed by A. T. Fancher, of Salamanca, to make this great forested region of mountains and valleys and picturesque trout streams one of the most attractive in the United States are bringing forth excellent results. The large number of tourists and campers who already have been attracted to the park show the importance and popularity of forest recreation.

LECTURES AT THE UNIVERSITY OF MICHIGAN

The following program of scientific lectures has been given for the students of the summer session of the University of Michigan.

July 5—*Fever*, Dr. C. W. Edmunds, professor of therapeutics and materia medica, University of Michigan.

July 12—*Causes of mental disorder*, Dr. A. M. Barrett, professor of psychiatry, University of Michigan.

July 14—*Niagara Falls and vicinity* (illustrated), Assistant Professor K. C. McMurry, department of geology, University of Michigan.

July 18—*The asteroids and rings of Saturn*, Mr. L. A. Hopkins, assistant professor of mathematics and secretary of the colleges of engineering and architecture, University of Michigan.

July 19—*The nature of cancer*, Dr. A. S. Warthin, professor of pathology and director of the pathological laboratory in the medical school, University of Michigan.

July 22—*How the psychologist tests intelligence* (illustrated), Mr. Guy M. Whipple, professor of experimental education, University of Michigan.

July 26—*Practical points in the prevention and treatment of cancer*, Dr. C. V. Weller, assistant professor of pathology, University of Michigan.

July 29—*Michigan's inland lakes: their value to the state* (illustrated), Mr. I. D. Scott, associate professor of physiographical geology, University of Michigan.

Aug. 1—*The senses and the learning process in fishes* (illustrated), Dr. J. E. Reighard, professor of zoology and director of the zoological laboratory and the zoological museum, University of Michigan.

Aug. 2—*Stone in the kidney*, Dr. Hugh Cabot, dean of the medical school, University of Michigan.

Aug. 4—*The nature of intelligence*, Professor L. L. Thurstone, of the Carnegie Institute of Technology.

Aug. 8—*Functions in high-school mathematics*, Professor E. R. Hedrick, University of Missouri.

Aug. 9—*Junior-high-school mathematics*, Professor E. R. Hedrick.

Aug. 10—*The conservation of health through food and drug inspection*, Professor C. C. Glover, secretary of the college of pharmacy, University of Michigan.

Aug. 12—*Acoustics of auditoriums* (with experimental demonstrations), Assistant Professor D. L. Rich, department of physics, University of Michigan.

Aug. 17—*Modern theories of matter* (illustrated), Dr. E. F. Barker, department of physics, University of Michigan.

Aug. 19—*Ten years of heredity* (illustrated), Professor A. F. Shull, department of zoology, University of Michigan.

BOOKLETS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The office of the permanent secretary of the American Association for the Advancement of Science has recently published two booklets that should be of interest to workers in science and other friends of science. The first of these, entitled "Resolutions bearing on Important Features of the Public Welfare," includes five resolutions that have already appeared in the pages of Science, and it also presents the list of general officers of the as-

sociation for the calendar year 1921. The second is "A Booklet of General Information, specially announcing the Second Toronto Meeting," which is to occur December 27–31, 1921. It includes preliminary information regarding the second Toronto meeting, with notes on the city of Toronto, and presents a succinct statement of the "Organization and work of the association." The latter topic is discussed under the following headings: "General scope," "Meetings," "Endowment and grants for research," "Publications," "Cooperation with other organizations," "Financial aspect of the work of the association," and "Conditions, obligations and privileges of membership and fellowship."

The last cover page of this booklet bears an instructive graph showing the growth of the membership list from 1848 (461) to 1920 (11,442). Copies of these booklets may be obtained from the permanent secretary's office.

SCIENTIFIC NOTES AND NEWS

Dr. George E. Hale, director of the Mount Wilson Observatory of the Carnegie Institution, was elected president of the Pacific Division of the American Association for the Advancement of Science at the recent Berkeley meeting.

At the opening meeting of the second International Congress of Eugenics, which will be held at the American Museum of Natural History, New York City, on the evening of September 22, addresses will be made by Professor Henry Fairfield Osborn, president of the congress; Major Leonard Darwin, president of the Eugenics Education Society, London; and Dr. Charles B. Davenport, director of the Department of Genetics of the Carnegie Institution.

The Paris Academy of Medicine has elected as foreign correspondents Professor L. J. Henderson, of Harvard University; Sir Robert Philipp, of Edinburgh; Sir Humphry Rolleston, of London; and Sir d'Arcy Power, of London.

At the June meeting of the Royal Society of New South Wales, Mr. R. T. Baker, curator and economic botanist of the Technological Museum, Sydney, was presented with the Mueller medal awarded to him by the Australasian Association for the Advancement of Science for his services to botany, particularly in regard to the Eucalypts.

Dr. R. Robles, of Guatemala, has been made a chevalier of the Legion of Honor by the president of the French Republic, in recognition of his discovery that the disease known in Central America as "coast erysipelas" is transmitted by a filaria.

Dr. Julius Lilienfeld, professor of physics at the University of Leipzig, has arrived in New York, where he has recently given a demonstration of his new roentgen-ray tube before the New York Roentgen Ray Society.

Dr. A. J. Hill, of New Hampshire, for twenty years a member of the Census Bureau and for several years chief statistician, has been appointed assistant director of the census.

Governor Sproul, of Pennsylvania, has appointed Dr. John M. Baldy as commissioner of welfare under the law which was passed at the last session of the legislature. The law creates a department of welfare to take over the work of the old state Board of Public Charities, the Lunacy Commission, the Prison Labor Board and other related activities. Dr. Baldy has been president of the State Board of Medical Education and Licensure since its creation in 1911, and is succeeded in this office by Dr. Irvin D. Metzger, Pittsburgh.

The British Civil List pensions granted during the year ended March 31, 1921, as reported in *Nature*, amounted to 1,200*l.*, and include the following: Mrs. Frederick Enock, in recognition of her husband's services to natural science and entomology, 100*l.*; Mr. Edward Greenly, in recognition of his services in the geological survey of Anglesey, 80*l.*; Mrs. J. A. McClelland, in recognition of her husband's distinguished services as an investigator in physical science, 100*l.*; Mrs. and Miss Sharman, in recognition of Mr. George Sharman's valuable services in palæontological science, 80*l.*; Mr. John Nugent Fitch, in recognition of his long services to the cause of

botany, horticulture, and natural history, 75*l.*; Mr. W. R. Hodgkinson, in recognition of his valuable scientific work in the public service, 100*l.*; and Mr. Herbert Tomlinson, in recognition of his services as a teacher, and of his valuable and distinguished contributions to physical science, 100*l.*

The title of emeritus professor of philosophy and comparative psychology in the University of London has been conferred on Mr. Carveth Read.

A statue of Donders, the great Dutch ophthalmologist and physiologist, was recently unveiled at Utrecht where he had been professor of ophthalmology and of physiology until his death in 1889.

According to the *Journal* of the American Medical Association, a tablet has been placed in the provincial hospital at Madrid commemorating the work of Dr. Achúcarro, the promising young histologist whose untimely death occurred a few years ago.

The name of Virtudes street in Havana has been officially changed to "Mayor Gorgas," and metal plates with the new name have been affixed.

A tablet with a portrait medallion of Sir William Ramsay, by Charles L. Hartwell, will be placed in Westminster Abbey as part of the Ramsay memorial.

George Trumbull Ladd, professor and emeritus professor of philosophy at Yale University for forty years, died on August 8, at the age of seventy-nine years. Dr. Ladd was the author of important books on philosophy and a leader in the development of physiological and experimental psychology.

Dr. O. Schmiedeberg, formerly professor of pharmacology at the University of Strasbourg, has died at the age of eighty-three years.

An examination for scientific assistant ($1,400 a year) in the United States Bureau of Fisheries, will be held on September 21. Applicants will be rated chiefly upon zoology in its relation to the fisheries, and general biology.

A bill to create a Department of Health has been introduced in the Japanese House of Representatives, in order to bring the various health organizations of the empire under the control of one department.

An Institute of Pathological Anatomy, named after Professor Hlava, has recently been inaugurated at the University of Prague. The institute is described as being the largest and best equipped of its kind in Europe.

The Committee of the Fifth Cuban Medical Congress, which will be held in December next, has decided to invite American, French and Spanish physicians and surgeons to attend.

An international exhibition for the promotion of hygiene will be held at Amsterdam, Holland, from October 8 to November 8. The exhibition includes the following: Feeding, clothing, housing, bodily cleanliness, labor hygiene, sport, dental care, infants' care, nursing, food adulterations, quack remedies, alcoholism, anti-tuberculosis movement, malaria, typhus, sex diseases, tropical hygiene, historical section. Apart from the above, there will be a commercial exhibition of clothing, foodstuffs and their packing, housing devices, wall and floor coverings, washstands, bathroom fixtures, kitchen utensils, suction sweepers, baby clothing, baby articles, sport clothing, sport articles, surgical instruments, dressing, equipment for operating rooms, dentists' and oculists' equipment, etc. Further particulars may be had from the Netherlands Chamber of Commerce, Beaver Street, New York City.

The *Journal* of the American Medical Association states that in the 1921 budget of the German government department for science and art, one specification is for 800,000 marks to continue the study of the Friedmann remedy for tuberculosis. Already several hundred thousand marks of government appropriations have been spent on the committee conducting the research. The *Deutcshe medizinische Wochenschrift* is quoted as remarking that it would be better to devote the money to maintaining the sanatoriums which are closing their doors for lack of

funds. The social insurance authorities have had to close the children's sanatorium at Lichtenberg and dismiss the personnel, and the full utilization of the great sanatorium at Beelitz is threatened.

The Henry Phipps Institute of the University of Pennsylvania has received a grant of $25,000 a year from the Carnegie Corporation, and $25,000 for two years from the university trustees. The conditions which must be met that advantage may be taken of the Carnegie grant are, first, the grant itself be expended for research, and second, there shall be previously expended for research not less than $50,000 a year, derived from other sources, in any year in which this grant is claimed.

A correspondent writes: "Dr. E. H. Sellards, geologist in the bureau of economic geology of the University of Texas, has been given leave from the University in order to undertake geologic investigations for the State of Texas in the Attorney General's Department relating to the Texas-Oklahoma boundary line on the Red River. The United States Supreme Court has held that the treaty of 1819 between the United States and Spain made the south bank of Red River the boundary between the two countries, and that by subsequent treaties and congressional acts this line as defined by the treaty with Spain has become the boundary line between Texas and Oklahoma on the Red River. However, there remain undetermined the questions: What constitutes the south bank of this river; where was the south bank approximately one hundred years ago when the treaty with Spain was made; and by what process has the river departed from its position of one hundred years ago, that is has the river moved gradually as by accretion to its banks, or suddenly as by ovulsion. The actual location of the boundary line between the two states for a distance of three hundred miles or more is contingent upon the Supreme Court's decision on these points to be made in accordance with the evidence that may be presented."

UNIVERSITY AND EDUCATIONAL NEWS

Vassar College receives $150,000, and Barnard College, Yale University, the University of Rochester and Colgate College, $10,000 each, by the will of the late Dr. Henry M. Sanders, formerly pastor of the Madison Avenue Baptist Church, of New York City.

Dr. P. P. Claxton, recently United States commissioner of education, has accepted the provostship of the University of Alabama.

Secretary Weeks, of the Department of War, has asked the University of Pennsylvania to release Major General Leonard Wood from his promise to become provost of the university in order that he may be free to accept the governor generalship of the Philippines.

As an *ad interim* measure, Dean Stanley Coulter has been appointed chairman of the faculty of Purdue University by the board of trustees and will administer all academic interests, while financial matters will be handled by a member of the board.

Dr. Charles D. Snyder has been appointed professor of experimental physiology in the Johns Hopkins University.

Dr. John C. Donaldson has accepted appointment as assistant professor of anatomy in the school of medicine of the University of Pittsburgh.

DISCUSSION AND CORRESPONDENCE

ANOTHER HIGH-TEMPERATURE RECORD FOR GROWTH AND ENDURANCE

A temperature record for growth and endurance of developing joints above that of any previously given was published by the senior author in Science for April 15, 1921. Young joints of *Opuntia* were found to continue elongation at 55° C. (131° F.) and to endure this temperature so that development was continued normally at lower and accustomed temperatures in March at the Desert Laboratory.

Measurements on other individuals with the advance of the season confirmed the earlier

results and have established a new high-temperature limit for active protoplasm in higher plants, also a new endurance record. The principal facts are as follows:

1. Joints of *Opuntia* were observed to maintain a fair rate of enlargement when at a temperature of 56.5° C., the air surrounding them being at 58° C. (137° F.).

2. Growth of young joints of *Opuntia* the temperature of which rose to 62° C. (144° F.) in an air temperature of 63° C. (146° F.) stopped and some shrinkage ensued, but growth or enlargement was resumed when their temperature fell to 50° C.

3. The young joints which were subjected to these temperatures were about 15 to 20 mm. in width and 25 mm. in length, and after being held at or near the record temperatures for an hour or more, which was repeated in one case, carried forward normal development, reaching maturity at a normal average of 100 mm. in width and 130 mm. in length.

4. It is to be noted that data from observations in which temperatures were taken from the air or from water in which the roots or aerial parts of plants were immersed, have but little value in any estimation of the working temperature of active protoplasm by reason of the abnormal hydration and transpiration conditions introduced. These conditions as well as the proportions and state of the main colloidal components must determine the temperature effects.

D. T. MacDougal,
Earl B. Working

Desert Laboratory,
Tucson, Arizona

A CALCULATOR FOR CONVERTING GAS CHAIN VOLTAGE INTO EQUIVALENT C_{H+} OR p_H VALUES

In the determination of hydrogen-ion concentrations by electrometric methods employing the hydrogen electrode, the step of finding the C_{H+} or p_H value from the measured voltage, with the aid of the working formula, though not difficult, is time-consuming. The extensive tables of Schmidt and Hoagland[1] simplify the process considerably. They give, in parallel columns, the voltages measured between a hydrogen electrode and a tenth-normal, and between the hydrogen electrode and a normal calomel electrode, respectively. With these are given the corresponding p_H, C_{H+} and C_{OH-} values, respectively. If the calomel electrode — because of difference in concentration of its potassium chloride solution, for example — has a different value, against the normal hydrogen electrode, from those assumed in these tables, a simple computation is necessary.

By definition, $p_H = -\log C_{H+}$, and the working equation, derived from Nernst's equation, shows these quantities to be linearly proportional to the measured voltage. If in all cases we had to deal with a single unvarying reference potential, the simplest procedure would be to draw the straight line, expressing the relationship, on a chart of rectangular coordinates, and to use this as the conversion chart. This plan, however, is not practicable in its application to all cases, because of the preferences of different workers for different types of reference electrodes.[2] Some prefer the tenth-normal, others the normal, still others the saturated type. In any given type, there are likely to be minor differences between different electrodes. To be able to apply the graphic chart to all cases requires that the straight line be capable of being shifted, parallel to itself at any one temperature, to correspond to the fundamental potential of the reference electrode being used.

Since it is a straight line relationship with which we are dealing, and since the variations mentioned do not change the slope of line, an instrument of the slide-rule pattern is not only feasible, but highly practicable. For convenience, the circular type was chosen. The C_{H+} and p_H scales are engraved on a disk 125 mm. in diameter. From the relation between these two quantities, their main divisions coincide; *e.g.*, for $p_H = 8$, $C_{H+} = 10^{-8}$.

[1] Univ. of Cal. Pub. in Physiol., 5, 23, 1919.

[2] A graphic conversion chart of the kind mentioned is reproduced in "Electrometric Methods and Apparatus for Determining Hydrogen-ion Concentrations," L. & N. Co., 1920, p. 25.

Of these main divisions there are 14, covering the entire range from normal acid to normal alkaline reaction. The 125 mm. disk is mounted by means of a central pivot on a second disk, having its scale of voltage around the circumference of the first. The range of the latter extends from 0.24 to 1.17 volts. Concentric with the disks is a movable arm of transparent celluloid, with a radial hair-line scribed upon it, to facilitate making readings. The points on the voltage scale corresponding to the potentials of tenth-normal, normal and saturated KCl calomel cells are marked, as a matter of convenience. The temperature for which the slide-rule gives correct readings is 25° C.

To use the instrument, the zero mark of the circular scale is set on the voltage corresponding to the reference electrode being used. The hair-line is set to indicate the measured voltage, and the corresponding p_H and C_{H+} readings appear under the hair-line on the inner disk. Settings are possible to an accuracy of ±0.5 millivolt.

The slide-rule can be used equally well when the reference electrode, instead of being the usual calomel half-cell, is a hydrogen electrode of known potential relative to the standard solution in which it is immersed. Whatever the nature of the fixed electrode, the change in potential difference at the terminals of the gas chain is 59.1 millivolts for each decimal change in the concentration. The graduation of the inner disk is based upon this assumption, which makes it applicable to any case.

Because of the fact that so few data are available on the variations of gas chain electromotive forces with temperature, it seems advisable, pending an accumulation of reliable information on this point, to make measurements at a temperature of 25° whenever this is possible.

Paul E. Klopsteg

MATHEMATICS IN SPANISH-SPEAKING COUNTRIES

The Spanish-speaking countries publish only one journal devoted to advanced mathematics, which is now called *Revista Matemática Hispano-Americana* and is published at Madrid, Spain, under editorship of J. Rey Pastor. In view of the fact that the professors of mathematics in so many countries can obtain no other advanced mathematical journal in their own language one might suppose that this periodical would not suffer for want of suitable manuscripts or sufficient financial support.

Such a supposition is, however, not in accord with the facts, judging from a call issued recently by its editor. In this call it is stated that there is now an almost complete lack of Spanish mathematical production and that it has been necessary therefore to publish an excessive number of articles by the same authors. It is also stated that nearly all Spanish professional mathematicians occupy the position of spectators and critics, and thus place the burden of doing the work connected with the periodical on the shoulders of one or two men.

In view of the fact that in the English-speaking countries of America the mathematical journals are now overcrowded by suitable manuscripts offered for publication it is interesting to note that just the opposite is true in the Spanish-speaking countries of this continent. As was noted in Science, N. S., volume 34, page 372, the Spanish-speaking people organized a mathematical society in 1911. This society has been fairly successful in awakening among them an interest in the newer fields of mathematics, but, judging from the call noted above, which was directed to the members of this society, it seems that this interest is still far from being general and effective.

G. A. Miller
University of Illinois

THE EARLIEST BEES, WASPS AND ANTS

It seems desirable to correct some statements appearing in text-books of geology, which lead students to imagine that we are acquainted with bees, wasps and ants from Mesozoic strata. Thus, Professor J. W. Miller,

in his "Introduction to Historical Geology" (1916), says (p. 232):

> Insects such as bees, ants and wasps made their first appearance in the Jurassic.

Dr. C. Schuchert, in "Historical Geology" ("Text-book of Geology," part 2), 1915, p. 812, states that "with the Comanchian . . . insects (beetles, flies, ants, bees, wasps) took their rise." As a matter of fact, the oldest known bees are from Baltic amber (Oligocene Tertiary), and the oldest known true wasps and ants are from the Eocene. In the Jurassic, the peculiar family Pseudosiricidæ, apparently related to the modern Siricidæ, were well represented. One species of this extinct family (*Megapterites mirabilis* Ckll.) has lately been described from the English Eocene. There is a very dubious Jurassic Hymenopterous insect from Spain, supposed to be related to the Ichneumonidæ. These Hymenoptera were not in any way adapted to be pollinators of flowers. Considering the development of the Hymenoptera in the Eocene, it may be presumed that the wasps and ants, at least, originated as early as the Cretaceous, but there is no direct evidence on the point.

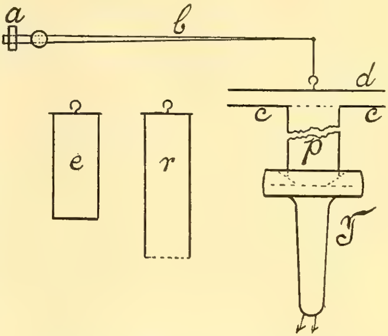
T. D. A. COCKERELL
UNIVERSITY OF COLORADO

SPECIAL ARTICLES

THE PNEUMATIC PARADOX IN ACOUSTICS

1. THE following pretty experiment is very instructive in its bearing on the Mayer-Dvorak effect, as well as on the experiments of the present paper. In the figure, *b* is the light wooden beam (30 cm. long, counterpoised at *a*) of a horizontal torsion balance, the torsion wire (of brass, .02 cm. in diameter and 18 cm. long on either side normal to the diagram) being seen at *w*. A light disc of cardboard *d* is suspended in equilibrium from the end of the balance. Below this is the telephone *T* to which the brass pipe *p* (13 cm. in length and 2.6 cm. in diameter) has been cemented, to form of a closed c'' organ pipe of which the telephone plate is the bottom. The open top of *p* is surrounded by a fixed annular disc *cc* of metal parallel and close to the movable disc *d*.

When the telephone is strongly energized and emits a rising note (motor break and rheostat), no effect is produced until its frequency is in resonance with the pipe *p*, whereupon the disc *d* is at once attracted. Since the pipe *p* is closed above by this process, the telephone frequency must be slightly reduced to keep the discs in cohesion. On breaking the current *d* is at once released.



This is of course nothing further than a modified example of the familiar pneumatic paradox. When the pipe howls, the distance from which *d* may be attracted and held is perhaps 2 cm. beyond which the couche of diminished static pressure is ineffective. The thickness vanishes with the intensity of sound.

2. If now *cc* is removed and the disc *d* is replaced by the closed paper cylinder *e* of a diameter (2.1 cm.) sufficiently small to enter the mouth of *p* easily, the results of the experiment are the same. Here however the cylinder *e* may be made to enter the pipe as much as 1 cm. or more by successively decreasing the pitch, conformably by the gradually stopped mouth of *p*. Supposing the total displacement to be 2 cm., the force indicated by the torsion balance would be .7 dyne and the mean pressure decrement for the area 3.5 cm.^{2}, therefore .2 dynes/cm.^{2} But as both the disc and cylinder come down with a jerk, the maximum forces are probably larger.

If there were a pin hole in the bottom of *e*,

the density of air contained would tend to increase and the cylinder fall for this reason also. But the present experiment is relatively too crude to show this. For the content of the cylinder *e* (6 cm. long) may be taken as 33 milligrams of air. The forces registered by the pinhole valve in experiments with resonators did not exceed $dp \mid p = 3 \times 10^{-4}$. Thus the increment of weight of *e* is but 10^{-2} dyne, which would lower the index of the torsion balance only .3 mm.

3. Finally let the closed cylinder *e* be replaced by the cylinder *r* open below and capable of entering the pipe *p*. Let the length of *r* be such that the open cylinder is in resonance with *p*. Then the conditions of the experiment are obviously improved (though not as much so in the experiment as anticipated[1]); but the results will still be the same in character. The open end of *r* will tend to enter the sounding pipe *p*; which is the equivalent of the Mayer-Dvorak experiment, here exhibited without any "neck" effect and without air currents.

4. I may add a comparison of the pin-hole compression observed in the given pipe (2.6 cm. diameter and 13 cm. long) when sounding loudly (*i.e.*, when resistance in the telephone circuit has been reduced as much as possible) and the compression observed in the open organ pipe of the standard form on the interferometer. The embouchured organ pipe, tested on the interferometer,[2] showed for the maximum compression $d\rho \mid \rho = 10^{-3} \times 14$ in case of a moderately loud note. The telephone closed pipe, tested with the pin-hole valve at the end of a quill tube thrust well within, gave a displacement of 20 fringes with 2,000 ohms in circuit. This is equivalent to a pressure increment of .0120 cm. of mercury when but 100 ohms are in circuit, as was approximately the case in the experiments of this paragraph. Thus in case of the probe $dp \mid p = 1.6 \times 10^{-4}$. Reservoirs at the U-tube of different volumes showed the same quantitative result. The increment (compression) does not quite vanish even in the plane of the mouth of *p*, but a little beyond. The ratio of the two compressions is thus 87; but while the interferometer direct gives a fringe displacement rarely exceeding 1, the pin-hole valve, under like conditions, will give fringe displacements easily several hundred times larger, depending on the degree of approach to the critical diameter of the pin hole.

Carl Barus

Brown University, Providence, R. I.

[1] On varnishing the paper resonator to stiffen it, forces above 2 dynes per cm.[2] were directly measured.

[2] Science, LII., p. 47.

THE KENTUCKY ACADEMY OF SCIENCE

The Kentucky Academy of Science held its eighth annual meeting on May 14th at the University of Kentucky, Lexington. The meeting was called to order at 9:30 o'clock by President Coolidge.

The secretary's report showed 127 members, including 44 national members, 55 local members, 21 corresponding members and 7 honorary members. These represent 37 different lines of activity of which chemistry leads with 26 members. Twenty-one new members were elected.

The report of the committee on legislation proposed a large program to be worked for, including a state appropriation for the support of the academy; awarding prizes for research; increased appropriations for completing the topographical map of the state and soil surveys; a natural history survey of the state and the establishment of a natural history museum; increase in the teaching of science in the high schools; the preservation of the records of drilled wells; the setting aside of areas for preserving natural conditions and the endorsement of the law now before Congress to make Mammoth Cave and its environs a national park. This report was adopted.

The officers elected were:

President, George D. Smith, State Normal School, Richmond, Ky.
Vice-president, Lucien Beckner, Winchester, Ky.
Secretary, A. M. Peter, Experiment Station, Lexington, Ky.
Treasurer, Charles A. Shull, University of Kentucky, Lexington, Ky.
Member of Publications Committee, D. W. Martin, Georgetown College, Georgetown, Ky.
Representative in the Council of the A. A. A. S., A. M. Peter.

The program included an address by Dr. Henry

B. Ward which was the principal feature of the afternoon session.

The following program was rendered:

President's address: *The relation of chemical training to industry:* W. H. COOLIDGE.

An experiment in mental and physical correlation: J. J. TIGERT, University of Kentucky, Lexington, Ky. By title.

Summary of the Thurstone intelligence tests for college freshmen and high-school seniors: WALTER E. ERVIN, Centre College. The average of 58 freshmen tested was 83, ranging from 30–39 (one student) to 150–159. The author remarks that such tests are not conclusive as to the mental equipment of any boy or girl, but they are helpful by placing the student in the school with more fairness.

The tragedy of the passenger pigeon: GEORGE D. SMITH, Eastern Kentucky State Normal School. The author described his observation of the wholesale destruction of the pigeons in their roosting place in a marsh, at night, by persons who came for miles around for this purpose, and hauled away the dead birds by the wagon load. This incident seems to have been one of the final stages in the extermination of the pigeon.

The last warning of the rattler: GEORGE D. SMITH, Eastern Kentucky State Normal School. The paper describes a fight which the author observed between a diamond rattlesnake and a large blue racer. The fight was long and fierce and ended in the destruction of the rattler. During the fight the racer is badly bitten by the rattler, hastens to a patch of weeds and bites several of the weeds, sucking out the juice. He then hastens back to renew the combat. In the progress of the fight the juice of the weed was applied a second time and the racer rushed back to renew the fight as before.

Absorption in the corn grain: CHARLES A. SHULL, University of Kentucky.

Orthogenesis in the Membracidæ: W. D. FUNKHOUSER, University of Kentucky. The attempt to explain the remarkable developments of the pronotum in the family Membracidæ by natural selection fails in the cases of the most bizarre and curious tropical forms. Poulton and others have suggested explanations based on protective coloration and mimicry which must be carried into the realm of speculation when applied to certain exotic species. Certain genera, including *Heteronotus*, *Centrotus*, *Pyrgonota* and *Spongophorus*, seem to show very regular pronotal development along definite lines when traced from the more generalized to specialized forms. This is particularly true of the length and position of the suprahumeral, dorsal and posterior horns. These developments seem in many cases to be entirely without regard to utility and even to threaten the existence of the species. In comparison with the classical example of the Irish elk, many species of Membracidæ seem to show even greater evidence of orthogenesis.

The progress of Kentucky in the second decade of the twentieth century: EDWARD TUTHILL, University of Kentucky

Kentucky petroleum problems: LUCIEN BECKNER. Kentucky offers many problems in petroleum geology which the consulting geologist and the geologist of the private company seldom have time to solve. The larger anticlines, the Cincinnati, north and south, and the Kentucky, east and west, present their peculiar characters that are not yet well understood. The author points out many problems which, could they be solved, would save the useless expenditure of thousands of dollars and probably result in the production of much wealth.

The first food of young black bass: H. GARMAN, Experiment Station, Lexington, Ky. A study of the food by use of the microscope on the stomach contents of both large- and small-mouthed black bass, taken from the State Hatchery pools at Forks of Elkhorn, Kentucky, showed that the dietary of both species during the first five weeks of their active lives consists of small crustaceans belonging to the orders Cladocera and Entomostraca, and of insect larvæ belonging to the dipterous family Chironomidæ. The percentages of the different kinds of food were determined and, as far as practicable, an exact determination was made of the crustacean species most prevalent in the dietaries. The purpose of the study was to learn just what food was most relished and how it might be influenced artificially for the benefit of young fishes produced at the hatchery.

The tolerance of hogs for arsenic: D. J. HEALY and W. W. DIMOCK, Experiment Station, Lexington. There is a popular belief that hogs are not very susceptible to arsenical poisoning and an examination of the literature failed to disclose a record of arsenical poisoning in hogs. The results of four tests made by administering arsenic trioxid are given. The total of 11 shoats received large doses of arsenic trioxid; in some

cases the doses were enormous. Nine of the shoats received, in addition to the arsenic, hog cholera virus. One animal died from acute arsenical poisoning, one from acute cholera, and one from an undetermined cause. It would appear from these results that young hogs possess a marked tolerance for arsenic trioxid.

Growing seedlings in test tubes with only filter paper pulp and distilled water: MARY DIDLAKE, Experiment Station, Lexington. The lower third of a test-tube is filled loosely with crumpled strips of filter paper, enough water to cover the paper is added and the tube plugged with cotton and sterilized in the autoclav. Sterilized seeds may be dropped in and allowed to germinate and grow. Soybean, cowpea, garden bean, garden pea, Canada field pea, vetch, alfalfa, red clover, Japan clover, velvet bean, peanut, locust, acacia, corn, wheat, hemp, and morning glory have been grown successfully in this way. Plants will grow thriftily for a month or six weeks.

Effect of frost and "soil stain" on the keeping quality of sweet potatoes: A. J. OLNEY, University of Kentucky. When the vines were cut away before frost, only 4 per cent. of the potatoes spoiled after storage at about 60 to 65° F. When the vines were cut immediately after a freeze, no loss occurred. When the vines were cut 5 days after the freeze the loss was 88 per cent. Potatoes badly affected with soil stain (*Monilochaetes infuscans*) but otherwise sound, sustained a loss of 55 per cent., while healthy checks suffered a loss of 12 per cent. Potatoes wrapped with paper sustained a loss of 20 per cent., as against 12 per cent. in those unwrapped.

Attempted inter-species crosses of the genus Nicotiana: G. C. ROUTT. Crosses were attempted among 7 species of *Nicotiana*. Of 911 flowers experimented with, 201 set seed. Only 4 of the 19 combinations proved fertile in both crosses and reciprocals, 4 proved fertile in one way only, and 11 proved infertile. Plants have not yet been grown from the seed obtained.

The production of antitoxin: MORRIS SCHERAGO, University of Kentucky. The method of producing diphtheria and tetanus antitoxin is described from the time the flasks of media are inoculated for the production of the homologous toxin until the antitoxin is ready for distribution. The factors influencing the potency of a toxin are discussed and the method of estimating the M. F. D. is outlined. The immunization of horses is discussed including the types of animals desired, preliminary treatment, dosage and time of injection. The time for taking trial bleedings and regular bleedings is indicated and the standardization of antitoxin is briefly discussed. The method of concentrating antitoxin is also described and discussed.

The inefficiency of the efficiency expert: P. K. HOLMES, University of Kentucky. Efficiency is the keynote in modern industry. Our modern "captains of industry" are giant efficiency experts. They often fail at the vital point because they do not apply their principles of efficiency to their own living, although they demand it of their employees who handle delicate machinery or assume big responsibilities for them. Big business can not long be efficiently done on artificial stimulants and by flabby muscles and shortness of wind. In the struggle for business supremacy only the strong survive. We must no longer be satisfied to live on a low health plane. We must have as our standard positive, and not negative, health. Such only is the basis of general efficiency.

On the trail of the Alaska salmon: DR. HENRY B. WARD, University of Illinois. The marvelous life history of the Alaska salmon has been worked out by the combined efforts of many investigators. In the early summer the adult fish appear off the coast, move forward into the inlets, start up stream, ultimately reach their spawning grounds, and having spawned, die. No adult salmon ever returns to salt water. The eggs rest in their gravel nests over winter and hatch out in the spring; the young fry play about in fresh water, descending slowly the streams until they disappear into the ocean. The markings on the scales carry a precise record of the age and wanderings of the fish in fresh water and in the ocean. Reasons for their movements in fresh water are not yet so well determined. The course they follow is very precise but the influences that direct it are still unknown. Partial explanations of the movements are to be found in the influences of the current of the stream and the temperature of the water. The application of these principles to special instances indicates the extent to which they serve to explain the complex problems involved in migration. The author described many of his observations while studying the salmon in Alaskan waters. He also brought out forcibly the importance of Alaska's natural resources, of which the salmon is one of the greatest.

ALFRED M. PETER,
Secretary

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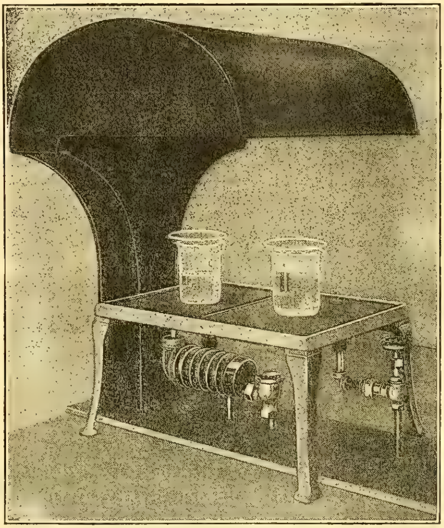

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WHOSE BUSINESS IS THE PUBLIC HEALTH?[1]

The larger the field of usefulness of any science or art, the more obvious its applications, the greater is its danger of exploitation. Just as real estate and insurance attract the business incompetent so does public health attract the intellectual "piker." All things to all men, dripping with statistical odds and ends, full of startling though often uncontrolled results, stamped with the hall-mark of altruism, public health draws the well-meaning and self-seeking alike. Even when based on the greatest accuracy that science affords it often becomes essentially inaccurate through the medium of its interpreters and its employment.

In this large forest of accuracies and inaccuracies, of scientific principles and their application, it would seem that one should counsel simplification rather than elaboration—and yet my idea is that we have not thought of public health in a large enough way—we have indeed failed to see the woods for the trees. What then is public health?

Let us recall, to begin with, that "health" means a normal condition not only of body but of mind and morals as well. We may stretch our definition a little further and following Henderson demand that "health" include not only a normal individual but a normal environment. The business of public health then consists in the detection, correction and prevention of the maladjustments of human life, individual and collective. The forces of public health are engaged in war against "The Kingdom of Evil." Some of you may recall the service that Southard rendered social workers in offering them an orderly classification of their labors. The analy-

[1] Address read in a Symposium on Science and the Public Health before the Pacific Division of the American Association for the Advancement of Science, Aug. 4, 1921.

sis of social maladjustment, according to Southard (1), should first of all be on the basis of the individual rather than the family and should proceed by a "process of orderly exclusion," weighing in turn the significance of disease, vice, delinquency, ignorance and poverty. These, then, are the provinces of the kingdom of evil.

We should conceive the public health program as embracing and extending this field of social service. I find it easy to explain how public health embraces this inclusive scheme of Southard's, but more difficult to state just how it extends it, other than in the way of specialized correction. Social work can scarcely be confined to simple detection of evil, leaving its correction and prevention to a more inclusive public health. Social work may then be a mere synonym for public health but of course the social worker as now conceived would be only one of the cogs in the machine.

To re-define, it is the function of public health to spy out and remedy the "ills that flesh is heir to," to deal with the individual and collective problems of disease, ignorance, vice, crime and poverty. It is evident we have here the whole tissue of human altruism, and have far outstripped the meaning of public health in common speech. What then are the discrepancies between the term "public health" as currently employed and the larger definition which, with possible prevision, I have here given.

Let us here correlate very briefly recent information as to the scope of public health. There exist in this country several well-established curricula, schools, or institutes of public health. What are the vocational fields for which they train their students? In what do their courses of training consist?

There are several statements by experts on the careers that are open to properly qualified students in public health work. Vincent (2), Winslow (3) and Ferrell (4) have all expressed themselves on this matter and with considerable unanimity. We may construct from their articles a composite picture of the public health field as they conceive it, as viewed from the aspect of its opportunities.

One of the most interesting aspects of our field is that it offers opportunities of usefulness to individuals of several different degrees of intellectual training. Thus we find that a class "A" which we may designate as "skilled workers" is required: clerks, stenographers, accountants and laboratory technicians. These individuals after an ordinary high-school education are trained through apprenticeship.

Class B includes the "professional workers." These individuals are the specialists and their assistants, with collegiate and usually graduate training and comprise several groups:

1. Administrators: directors of public health schools, public health laboratories, bureaus and the like.

2. Laboratory workers: statisticians, bacteriologists, zoologists with various subgroups, immunologists, chemists and physiologists.

3. Field workers: public health nurses, sanitary engineers, epidemiologists, physicians, particularly school health officers, and social workers.

Although there is rather general agreement concerning most of these occupations and professions that together compose "public health" as now understood, it is evident that new groups are being added, that there are as yet "untilled fields," as Winslow has expressed it.

If vocational fields as ample as these exist, if tillers of these fields are in demand it is evident that they must be trained in other than the haphazard way that was necessary with the pioneers. Hence the "school of public health" the present conception of which now occupies us. A survey of the courses required and offered in four of the leading schools of public health in this country, Harvard-Technology, Yale, Pennsylvania and Johns Hopkins, shows certain accepted standards and suggests the lines of further advance that are contemplated. We shall not here concern ourselves with prerequisites and degrees granted but consider only what may be regarded as the fullest training offered.

It is evident that public health training for other than medical graduates requires practically the first two years as given in first class medical schools, that is, complete courses

in at least physiology, biochemistry and bacteriology. Anatomy is required at Hopkins and Harvard and the latter school also requires introductory pathology. It is evident that we are approaching the curriculum recently advocated by Sedgwick (5), who advised identical training for medicine and public health students for two years with divergent paths for two years more. Public health further requires somewhat more elaborate training of its students in certain branches of zoology, notably in parasitology, protozoology, helminthology and entomology, than is usually required of medical students.

Then come the medical and pre-medical sciences specifically applied to public health problems. Advanced physiology particularly of fatigue, respiration, climatology and ventilation; chemistry as applied to nutrition and metabolism, food, food adulteration and sanitation; bacteriology as applied in public health laboratories and to sanitary engineering.

And lastly are the public health sciences properly speaking: vital statistics, public health administration, sanitary law, sanitary engineering, epidemiology, school inspection, control of contagious diseases, and the like.

The total curriculum is certainly medical enough in aspect, which accounts for the very natural supposition in the minds of the general public and of many of the medical profession that public health is simply another specialty of medicine. How far wrong this conception is I shall hope to bring out a little later. Let it suffice here to note that the medical bulk of public health as outlined in schools of public health is preventive medicine and not curative medicine, medical science and not medical art. This is clearly brought out by the almost complete absence in all these curricula of the medical clinic. The hospital is not a necessary adjunct in public health training.

In finally considering the scope of public health we may glance at it as mirrored in current textbooks. Here at least no practical consideration of money or men need limit the field to be covered.[1] Again the main emphasis very properly lies in disease prevention with rather more emphasis than in the course outlines on certain correlated branches of personal hygiene and community welfare; the construction of dwellings; the question of clothing; the group care of infants and school children; health measures as applied to prisons, to armies, to transportation, and the tropics. A wider field is suggested by mention at least of such deeply specialized fields as mental hygiene (Park) and eugenics (Rosenau).

[1] Rosenau (6), Park (7), and Abel (8) were consulted in this connection.

It is evident then from these summaries that public health is primarily concerned and properly so with the abolition of disease and in this campaign has enlisted the cooperation of many specialists outside the field of medicine. We suggest again that its future lies in the further assumption of the burden of combating ignorance, vice, crime, and poverty. What then is the actual and prospective personnel of the army of public health workers? Since disease is and will probably remain its most serious, tangible and defeatable enemy the man with a medical training is the most considerable figure in the scheme. Undoubtedly a full medical training remains the best foundation on which to base a further training in the broader field of public health. As an entire training medicine alone is inadequate, and to the type of mind that remains satisfied with accomplishment of the diagnosis and cure of an individual case of disease, it may even be detrimental. This is no place for the guild-consciousness of the practitioner of medicine. As a matter of fact the graduate in medicine is no longer of necessity the forwarder of those very sciences on which the art of medicine depends. If it be true that physiology, bacteriology, biochemistry and anatomy are progressing in the hands of non-medical specialists to the ultimate advantage of medical practise, this is even more true of the field of public health. No one would dream of asserting that one must have a medical training to be a good sanitary engineer, social worker, or criminologist. In this connection it is of interest to note that less than half the faculties of

the Yale and of the John Hopkins Schools of Public Health are doctors of medicine.

May I point out then in conclusion that there are a number of fields of human endeavor that have been largely or entirely overlooked in efforts to present the scope of public health? They overlap each other and the fields already recognized.

The whole field of social economics has been notably neglected. The study of poverty, care of dependents, the question of housing from the standpoint of the inhabitant; some conception of city government, and the labor problem may be mentioned as contributory in this training.

Further consideration of industrial hygiene is necessary not simply from the standpoint of occupational diseases and accident prevention but from the aspect of labor education and efficiency.

There is a group of studies that may be included under mental hygiene: psychology; abnormal psychology; criminology, the studies of vice, and delinquency. Closely related thereto are the endeavors in child hygiene and child welfare, eugenics, juvenile court work and the like.

Somewhere in the scheme I am sure should come certain aspects of physical education as a building method of the healthy mind and body. And perhaps, as Vincent has suggested, we should consider some forms at least of proper publicity and education of the masses in the results of public health work.

The whole business of public health action then seems dependent on those who have specialized information in any one of the numerous branches that have and will comprise it. The further development of this art depends on those with successively larger visions of what's wrong with the world.

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THE ABORIGINAL POPULATION OF CALIFORNIA[1]

The only attempt to compute the aboriginal population of California is that of C. Hart Merriam in the *American Anthropologist* for 1905. His figure of 260,000 was obtained thus: In 1834 there were 30,000 converted Indians at the Missions. The addition of unconverted Indians within the Mission area would make 40,000. The population at the Missions had suffered a decline; correct therefore to 50,000 for aboriginal times. The Missionized area embraced one fifth of the habitable area of the state. The total would be 250,000; to which add 10,000 in the mountains and deserts.

This computation appears to err on the side of the area tapped by the Missions, which should be estimated at one third rather than one fifth of the total, reducing the result to 150,000 or 160,000.

Calculations gradually made during the past twenty years suggest a still lower figure, 133,000. This is the aggregate of the closest possible estimates which can be made for individual tribes and groups. For instance, a close survey of the Yurok shows them inhabiting between 50 and 55 settlements at the time of discovery. The houses averaged 6 per settlement, the inmates 7.5 per house. The total of approximately 2,500 for the Yurok, together with less complete data on number

[1] Abstract of a paper presented before the Section of Anthropology, American Association for the Advancement of Science, Chicago.

of settlements among neighboring tribes and valuations of their territory as to food supply, allows figures to be set for these other tribes. The figures for the entire district can then be used as a check on estimates made independently from local sources for other districts, due regard being given to variety of geographic conditions. In this way the total is arrived at.

The best early data are those from Spanish sources, which sometimes include approximate counts. Early American figures are usually impressionistic and exaggerated.

A check is furnished by the large Yokuts group. Here Moraga in 1806 computed 3,760 souls in thirteen tribelets, an average of 290. The inclusion of absentees might bring the figure to 350. Nearly 50 such tribes are known among the Yokuts, with a small part of their area unaccounted for. The total population of the stock thus was about 18,000. Its area embraced about one ninth of modern California and seems about average in food-supplying capacity. Multiplying 18,000 by 9 gives 162,000. A deduction of one fifth for the larger blocks of high mountain and desert areas brings the total to about 130,000; a reasonable verification.

Of course, no figure can be more than an approximation; but it seems at least highly probable that the native population fell between 120,000 and 150,000.

Even this total, the lowest ever arrived at, yields the unusual density of nearly one inhabitant per square mile for aboriginal California. Mooney's estimate is about 1,050,000 for the continent north of the Mexican boundary; 846,000 within the limits of the United States exclusive of Alaska.

The latter figure however, seems to contain Merriam's 260,000 for California. Reduced to conform to the new estimate of 133,000, the population of the United States would not much have exceeded 700,000, or one inhabitant per four square miles. In other words, more than a sixth of the Indians of this country were settled in California. A similarly heavy concentration seems to have held good for the Pacific coast of the continent as far north as Alaska.

The decrease of Indians in California has reached fully 85 per cent. in a century and a half. The factor most favorable to heavy decrease has been immediacy of contact with Caucasians and Caucasian civilization. Other factors have intervened to make the result somewhat irregular; but these are too dependent on local circumstances to make their analysis possible here.

A. L. Kroeber
University of California

THE CENTENARY OF THE BIRTH OF HERMANN VON HELMHOLTZ

Scientific men of the twentieth century are so engrossed in their various pursuits (for which, happily, material equipment far in excess of anything dreamed of fifty years ago is provided) that they are in some danger of forgetting, overlooking or even ignoring the work of their predecessors of the nineteenth century.

It is upon fundamental discoveries in electricity and magnetism made during that century, and especially upon the two great generalizations, the law of the conservation of energy and the doctrine of evolution, which together constitute its great glory, that the present generation is building a brilliant, though a somewhat complicated and bizarre superstructure. It may be well, therefore, to remind the group of busy younger men who read the pages of Science, that one hundred years ago, August 31, 1821, was born one who must always be ranked with the very first—the three or four very first—of those upon whose work twentieth century science rests.

Hermann Ludwig Ferdinand, Baron von Helmholtz, was the son of a professor of philology and philosophy at Potsdam. His mother was a Hanoverian lady, a direct descendant of William Penn.

Exhibiting at an early age a fondness for the study of natural phenomena, the necessity for a vocation by which he could earn a living directed him to the medical profession and his first appointment was as an army surgeon.

At the age of twenty-one years he published his first paper announcing the discovery of nerve cells in ganglia, the beginning of a steady flow of contributions to science from his pen, interrupted only by his death more than fifty years later.

At twenty-six he had produced what was possibly the most important piece of work of his whole career, namely, his famous paper on the conservation of energy. Refused for publication by *Poggendorff's Annalen,* its value was appreciated by Du Bois-Reymond, who presented a copy of it to Tyndall (then a student at Berlin) with the remark that it was "the product of the first head in Europe." This paper fixed his place as one of that immortal trinity, Joule, Helmholtz and Kelvin, to whom we owe the establishment of this great law.

An account of Helmholtz's principal contributions to science was given in this journal not long after his death, together with the leading incidents of his long career.[3]

In one respect he was unique. No other man of his day approached him in the wide range of his intellectual activities, ranking, as he did, among the first of mathematicians, physicists, and physiologists, besides being claimed as "their own" by chemists and musicians. His contributions to the science of astronomy and of theoretical mechanics are of the highest order and in respect to his prodigious learning and the wide scope of his investigations he may be put in the same category with Francis Bacon and his own renowned fellow countryman, Alexander von Humboldt. The enormous extension of the bounds of human knowledge within the past fifty years and the irresistible tendency to specialization make it certain that there will never be an addition to this group.

Helmholtz's intellectual processes were in a marked degree typical of the race to which he belonged. They were not characterized by brilliant sorties but rather by steady advances accompanied by entrenchments so safe and strong that he was rarely if ever obliged to retreat.

There was a certain massiveness of style in both his speech and composition which made his arguments a little more difficult to follow than was the case with his two or three more brilliant contemporaries. The charm of his personality will not be forgotten by those who had the good fortune to come within its sphere. With much dignity of manner he was easy of approach, simple and modest in his mode of life, eloquent in speech in popular addresses on scientific subjects, and to those who had tried to find the man in his published works, unexpectedly delightful in social intercourse.

Physically he was not above the average in height and in figure much like that of the well-bred and well-fed German. The one small disappointment was his head which, though large, did not in shape at once proclaim his intellectual superiority, as did that of von Humboldt.

Personally chosen by the Kaiser to represent the German Empire, he came to the United States at the time of the World's Fair in Chicago in 1893. He was honorary president of the International Electrical Congress, with its "Chamber of Delegates" assembled at that time and through the kindness of friends, official and unofficial, all of whom were glad to do him honor, he was enabled to see the places and things most worth seeing in this country which he had never before visited.

On the voyage back to Germany he met with an accident which resulted finally in his death in September, 1894, mourned, as he had been beloved, by people of every nationality and all ranks of life.

The then youthful Kaiser, who was very fond of von Helmholtz and who two years earlier on the occasion of his seventieth birthday, had placed him at the head of the civil list, judged wisely in selecting him as the "highest product of the Empire" and in pure intellectual power he will always rank with the foremost men of the nineteenth century.

T. C. Mendenhall

Ravenna, Ohio

[1] Science, No. 58, February 7, 1896.

SCIENTIFIC EVENTS

DEATHS OF GERMAN MEN OF SCIENCE[1]

AT our request, Professor C. Runge, of Göttingen, has been good enough to send us the following list of leading men of science in Germany who have died since the beginning of the late war. The list is not, however, complete, and may be supplemented later. Short obituary notices of some of the men will be found in the *Geschäftliche Mitteilungen der Göttinger Gesellschaft der Wissenschaften*, 1918–19–20 (Weidmannsche Buchhandlung, Berlin S.W. 68, Zimmerstr. 94):—W. Lexis, mathematician and statistician, August, 1914; W. Hittorf, physicist, November, 1914; A. von Auwers, astronomer, January, 1915; A. von Könen, geologist, May, 1915; E. Riecke, physicist, June, 1915; P. Ehrlich, physician, August, 1915; H. Solms-Laubach, botanist, November, 1915; R. Dedekind, mathematician, February, 1916; E. Mach, philosopher and physicist, February, 1916; K. Schwarzschild, astronomer, May, 1916; R. Helmert, mathematician and physicist, June, 1917; A. von Baeyer, chemist, August, 1917; G. Frobenius, mathematician, August, 1917; A. von Froriep, anatomist, October, 1917; H. Vöchting, botanist, November, 1917; C. Rabl, anatomist, December, 1917; G. Cantor, mathematician, January, 1918; L. Edinger, physician, January, 1918; E. Hering, physiologist, January, 1918; F. Merkel, anatomist, May, 1919; S. Schwendener, botanist, June, 1919; E. Fischer, chemist, July, 1919; H. Bruns, astronomer, 1919; Th. Reye, mathematician, July, 1919; W. Voigt, physicist, December, 1919; P. Stäckel, mathematician, December, 1919; W. Pfeffer, botanist, January, 1920; O. Bütschli, zoologist, February, 1920; and W. Förster, astronomer, 1920. J. Elster, physicist, and Joh. Thomae, mathematician, have died recently. In addition to the above, several other German men of science were referred to in the obituary notice of Professor von Waldeyer in *Nature* of May 19, and news has also reached us of the following deaths not previously recorded in these columns:—Professor G. A. Schwalbe, Strassburg, on April 23, 1916, age seventy-one years; and Professor Karl von Bardeleben, editor of the *Anatomischer Anzeiger*, on December 19, 1918, age sixty-nine years.

[1] From *Nature*.

PROGRESS IN THE WORK OF MAPPING THE UNITED STATES

THE United States Geological Survey, Department of the Interior, has published about 3,000 engraved topographic maps, which represent nearly 43 per cent. of the area of the United States. These maps are the results of surveys made during a period of 34 years, and the results are fairly good in quantity and quality for a Government bureau which can go only as fast as appropriations will permit.

A few geologic maps were published by the Survey prior to 1886, some of them in atlases accompanying reports on regions in the West, and a few were published separately as photolithographs; but the 1-degree sheets of northwest New Mexico and northeast Arizona, known as Wingate and Mount Taylor, N. Mex., and Fort Defiance, Tusayan, Marsh Pass, and Canyon de Chelly, Ariz., published in 1886, were the first topographic maps printed by the Geological Survey from engraved plates.

Eight States—Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, Maryland, West Virginia, and Ohio—have been completely mapped, and the work of mapping the State of New York is more than 90 per cent. completed. Several States are actively cooperating with the Survey in this work and in 1920 contributed to it a total of nearly $200,000.

The Bulletin of the Survey containing this information continues:

With nearly 60 per cent. of the area of the country entirely unmapped and much that has been mapped in need of resurveys, and with the largest mapping organization in the country surveying only about 40 per cent. of the area in 40 years, the logical demand is for more speed. If these maps are to serve their full purpose in promoting national development the whole country must be mapped within this generation, or, even

better, within the next decade. Practical engineers realize that every dollar of Federal and State funds appropriated for these surveys, if spent in the next twenty years, will save many dollars that otherwise must be spent by corporations and individuals in fragmentary surveys made for special purposes, and the worst feature of such an uneconomic procedure would be that it would provide no maps for the use of the general public.

THE TONGASS NATIONAL FOREST

One million cords of pulpwood on the Tongass National Forest, Alaska, has been sold by the Forest Service of the United States Department of Agriculture to the Alaskan-American Paper Corporation. The timber is from the east shore of the Behm Canal, Revillagigedo Island, about 32 miles from Ketchikan, the largest city in the Territory. The contract price of the timber was 60 cents per 100 cubic feet for spruce and cedar, and 30 cents per 100 cubic feet for all other species. The sale area covers 45,000 acres, and extends for 55 miles along the coast. Twenty per cent. of the forest is spruce, 66 per cent. hemlock, and 14 per cent. Alaska and western red cedar.

A conditional award has been made by the Forest Service to the company, pending approval by the Federal Power Commission of their application for a hydro-electric power license. The timber sale contract covers an initial period of 32 years, or until 1953. The price of the stumpage will be redetermined and fixed by the Federal Government in 1928, and every five years thereafter. Cutting must begin by October 1, 1923, thus allowing two years for organization and construction of improvements. The contract also requires the establishment of a pulp mill of not less than 25 tons capacity by October 1, 1926. A yearly cut of from 2,500,000 to 3,000,000 cubic feet is contemplated.

The award of this sale is in line with the general policy of the Forest Service for making available the timber resources of Alaska as a means of increasing the supply of pulpwood for the United States. The national forests of the Territory probably contain 100,000,000 cords of timber suitable for the manufacture of newsprint and other grades of paper. Under scientific management, experts say these forests can be made to produce 2,000,000 cords of pulpwood annually for all time, or enough to manufacture one third of the pulp products now consumed in this country.

The Alaska forests also contain the second chief essential of the pulp and paper manufacturing industry, namely, water power. No accurate survey of the power resources has yet been made, but known projects have a possible development of over 100,000 horsepower, and it is believed that a complete exploration of the national forests in southern Alaska will show not less than 250,000 potential horsepower that can be developed from water.

Forest Service cruisers are now working in Alaska collecting data for further use and development of the forests. One block of timber containing 335,000,000 cubic feet—enough to keep a 100-ton pulp mill running—has been advertised and is now ready for sale.

THE ROOSEVELT WILD LIFE MEMORIAL

The wild life memorial established by New York State to Theodore Roosevelt, The Roosevelt Wild Life Forest Experiment Station at Syracuse, is this summer conducting field investigations in New York State in the newly established seven thousand acre Allegheny State Park, which lies south of Buffalo on the Allegheny River. Here Mr. Aretas A. Saunders is investigating the birds, and Professor T. L. Hankinson the fishes. Through friends of the station funds have been provided to investigate the beaver in the Adirondacks, where numerous complaints of the injuries have necessitated a study of their present status. This investigation is being made by Dr. Charles E. Johnson. Through the cooperation of President Howard H. Hays, of the Yellowstone Park Camps Company, and with the approval and cooperation of Director Mather, of the Park Service, and of Superintendent Albright, of the Yellowstone National Park, a field party has been at work in the Yellowstone studying wild life problems, with headquarters at Camp Roosevelt, in the north-

eastern corner of the park. Dr. Robert A. Muttkowski has been making an investigation of the fish food producing capacity of the trout streams, and Dr. Gilbert M. Smith the relation of the aquatic plants to this fish food supply. Mr. Edward R. Warren, assisted by Mr. Ellis L. Spackman, is making an intensive study of the beaver, including the mapping of their dams and ponds. Another friend of the station has made it possible for Mr. Edmund Heller, formerly naturalist on the Roosevelt African Expedition, to conduct for the station an investigation of the status of the large game mammals of the park.

SCIENTIFIC NOTES AND NEWS

AT the opening session of the New York meeting of the American Chemical Society, which will be held at Columbia University, New York City, on September 8, Dr. Edgar F. Smith, provost emeritus of the University of Pennsylvania, will preside, and addresses will be made by Mr. Herbert C. Hoover, secretary of the Department of Commerce, and Sir William Pope, president of the British Society of Chemical Industry.

THE French Association for the Advancement of Science met during the first week in August at Rouen under the presidency of M. Rateau.

DR. HENRY GORDON GALE, professor of physics in the University of Chicago, and dean of the colleges of science, has been made chairman of the division of Physical Science of the National Research Council, Washington, D. C.

DR. HENRY H. DONALDSON, professor of neurology at the Wistar Institute, has been elected a foreign corresponding member of Il Reale Istituto Lombardo di Scienze e Lettere di Milano.

PROFESSOR HEINRICH O. HOFFMAN, of the Massachusetts Institute of Technology, has been elected an honorary member of the American Institute of Mining and Metallurgy.

DR. WALTER NERNST, professor of chemistry, has been elected rector of the Berlin University.

MR. J. SHEPPARD, of the Municipal Museums at Hull, has been elected president of the British Museums Association.

DR. W. J. HUMPHREYS, of the Weather Bureau, has been elected secretary of the American Geophysical Union, to succeed Dr. H. O. Wood, resigned.

E. G. MONTGOMERY, professor of agronomy in Cornell University, has been named by Secretary Hoover as chief of the food-stuffs division of the Bureau of Foreign Commerce.

MR. ROBERT C. DUNCAN, physicist of the Bureau of Standards, has accepted a position with the Bureau of Ordnance of the Navy Department.

PROFESSOR PAUL ANDERSON, dean of the School of Mechanical and Electrical Engineering at the University of Kentucky, has been appointed director of the research laboratory of the Heat Engineering Society at Pittsburgh.

EDWARD F. MCCARTHY, of the New York State College of Forestry at Syracuse, has been assigned to the new forest experiment station of the U. S. Forest Service at Ashville, N. C.

PROFESSOR G. F. WARREN, of Cornell University, has been requested by Mr. Wallace, Secretary of Agriculture, to serve as consulting specialist to the chief of the Bureau of Markets and Crop Estimates during the reorganization and consolidation of the bureau. Professor Warren has accepted and has been granted leave of absence from Cornell until February 1, 1922.

DONALD D. SMYTH, instructor in economic geology at Cornell University, has accepted a position as geologist with the Cerro de Pasco Copper Corporation of Peru.

FOREIGN zoologists who attended the recent summer meeting of the American Phytopathological Society included Dr. E. J. Butler, director of the Imperial Bureau of Mycology, Kew Gardens, Surrey, England, and Dr. Kingo Miyabe, of the College of Agriculture, Hakkaido Imperial University, Sapporo, Japan.

DR. P. H. AASER, director of the Norwegian

State Hygienic Laboratory, Christiania, is visiting laboratories in the United States for the purpose of studying their organization, equipment and functions.

Galen H. Clevenger, consulting metallurgist to the United States Smelting, Refining and Mining Company, and vice-chairman of the Engineering Division of the National Research Council, has returned to Boston after a sojourn of four months in Mexico, organizing and directing research.

Professor H. H. Whetzel, of Cornell University, is planning to spend a year in Bermuda devoting his time to a survey of the fungi of the islands, especially those species causing plant diseases.

Professor Rollin T. Chamberlin, who has been spending the spring and summer months in the Alps, in the study of the internal motion of glaciers by the use of a delicate time-recording shear-meter devised for the purpose, reports that he has obtained records of actual shear movement. The motion takes place by little starts and stops, as might be expected in an elastico-rigid body, and not by uniform or steadily progressive motion, as might be expected in a viscous body. After completing his glacial studies, about mid-summer, Professor Chamberlin expects to give some time to the structure of the Alps and to certain geological phenomena in Spain.

The John Burroughs Memorial Association has been inaugurated at a meeting of a number of his friends at the American Museum of Natural History, the immediate purpose of the association being to protect Mr. Burroughs's home and camps and to preserve them, with their wild life, for future generations. The committee appointed to complete the organization included Dr. Frank M. Chapman, Dr. G. Clyde Fisher, Mr. Carl E. Akeley, Mr. Hamlin Garland, Judge A. T. Clearwater, Mr. Kermit Roosevelt, Mrs. Thomas A. Edison, Mrs. Henry Ford, and Mr. W. O. Roy.

A memorial window in the Episcopal Church of St. John's in the Wilderness, at Paul Smiths, N. Y., the gift of Mr. William Rockefeller, was dedicated on August 7 to the memory of the late Dr. Edward Livingston Trudeau.

We learn from *Nature* that the council of the Society of Chemical Industry has decided to institute a Messel memorial lecture in memory of Dr. Rudolph Messel. A gold medal with an honorarium will be presented to the lecturer, and for the present the remainder of the income from the bequest to the society will be allowed to accumulate.

The Royal Society proposes to erect a monument to Lord Lister in Portland-place, near the house where he lived. The necessary funds have been provided.

The park that has been constructed opposite the headquarters of the national public health service in Havana has been named for Dr. Carlos J. Finlay, and a statue portraying him was recently unveiled. It stands in the center of the park, and it is proposed to place in the corners of the park statues of the three members of the American commission, Dr. Reed, Dr. Carroll, and Dr. Lazear, who with Dr. Agramonte, confirmed the transmission of yellow fever by the mosquito.

Orestes M. St. John, formerly geologist on the surveys of Iowa and Illinois, has died at San Diego, California.

The British Medical Journal states that a scholarship has been founded at the Manchester Royal Infirmary primarily for the investigation of the claims made, especially in Germany, for the intensive X-ray treatment of cancer. The anonymous donor, however, desires that the inquiry shall include the study of the cancer problem from any point of view that may arise, and also an inquiry into the precautions that should be taken for the protection of persons working with highly penetrative rays. The scheme under which the scholar will work has been framed by a committee, consisting of Sir William Milligan, Professors H. R. Dean and W. L. Bragg, Dr. A. Burrows, Dr. Powell White, Mr. James Watts, and Dr. A. E. Barclay. Dr. C. C. Anderson has been appointed the first scholar, and will visit various centers where the intensive method is in use. He will then return

to Manchester to carry on the investigation in collaboration with other workers, who will attack the problems arising from the pathological and physiological standpoints. It is intended that the first visit should be made to Erlangen, but if time permits the scholar will afterwards visit Freiburg, Berlin and Mannheim, and certain centers in France, Holland and Sweden.

A report of the British Interdepartmental Committee, which was asked to prepare a scheme for giving effect to the resolutions of the British Empire Forestry Conference with regard to a central institution for training forest officers, has been issued. The committee recommends that such an institution should be placed at Oxford and incorporated with the university. It should be governed by a board appointed one half by the departments or governments concerned, and the other half by the university. The board should have general charge of the higher course of training, of finance, and of administration. The director of the institution, who should be the professor of forestry, and the staff should be appointed by the university with the approval of the board. Pending the erection of buildings, arrangements can be made with the university for temporary accommodation. The committee says that the annual cost of the permanent staff should not at the beginning exceed £4,000 per annum. There will be a further liability on every department concerned for the university fees and subsistence, estimated at £300 a year for each probationer. Students should be selected by the departments for admission to the central institution from those who have taken a forestry degree at any university whose standard of education is approved by the board.

At the last annual meeting of the American Physiological Society a fellowship for research in physiology was established by the generosity of Dr. Wm. T. Porter, of the Harvard Medical School. By resolution of the society, the council has been instructed to receive nominations and appoint the fellow for the year 1921–22 with a stipend of $1,200. The fellowship may be pursued at the university or institution where the particular problem being developed by the candidate can best be forwarded. The proposed program of investigation is limited only by the general purpose, namely, the pursuit of physiological research. But the program submitted by the candidate must meet the approval of the council of the society.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Frances Appleton Foster, of Weston, Mass., the Massachusetts Institute of Technology receives $1,000,000 and Wellesley College $500,000.

It is reported from the University of Manitoba that requirements for securing the gift of $500,000 from the Rockefeller Foundation will be fully met and that another new building will be erected on the college grounds.

Professor R. R. Fenska has resigned as assistant professor in forestry at the University of Montana to become professor of forest engineering at the New York State College of Forestry, Syracuse University.

Mr. Dwight Isely, scientific assistant in the United States Bureau of Entomology, has resigned and has accepted the position of associate professor in the Department of Entomology, University of Arkansas, and associate entomologist in the Experiment Station.

John R. Du Priest, professor of steam and gas engineering and design in the Rensselaer Polytechnic Institute, and consulting engineer for the Endicott Machine Corporation, Baltimore, has been appointed assistant professor of mechanical engineering at the Oregon Agricultural College.

Herbert C. Hanson, of the University of Colorado, has been appointed assistant professor of biology in the University of Arizona.

The Linacre chair of zoology and comparative anatomy, at Oxford, vacant by the retirement of Professor G. C. Bourne, has been filled by the appointment of Professor E. S. Goodrich, fellow of Merton College and professor of comparative embryology in the university.

DISCUSSION AND CORRESPONDENCE

THE TEMPLE HILL (ORANGE COUNTY, N. Y.) MASTODON

The 101st separate record of mastodon remains in the state of New York and the 31st record for Orange County, have been made by the recent discovery of an almost complete skeleton on the muck lands near Temple Hill about three quarters of a mile northwest of Vail's Gate Junction. The discovery is of exceptional interest. Next to the Warren Mastodon which stands in the American Museum of Natural History, the Temple Hill skeleton follows in order of completeness, all bones being present except a part of the cranium and a few of the ribs. While the skeleton appears to be somewhat larger than that of the Cohoes Mastodon in the New York State Museum, it is evident that the bones are those of a young animal, as the epiphyses are free and there is a full set of four intermediate molars in addition to the complete permanent molars, making in all 12 teeth in both jaws. The animal was found lying on its side with a quantity of triturated plant remains, apparently tamarack, lying between the ribs, evidently the creature's last meal. The skeleton was discovered about the 10th of June and was immediately acquired for the State Museum through the generosity of an appreciative friend.

The Mastodon was the most conspicuous member the mammal fauna of New York ever had, and it is perhaps of special interest to again note, with this occasion, the great abundance of these creatures in the state during the time of the recession of the post-glacial waters, especially over the swampy highlands before the land had settled down to its present altitude. After all the disturbances to which the soil of New York and its contents have been subjected, the wasting by the weather and the various other agencies attacking and destroying the integrity of such remains, the abundance of the recorded discoveries of mastodon bones in the state can only be interpreted as indicating the fact that in their heyday these animals were as abundant here as the buffalo were on the plains 75 years ago; and it is also a fact worthy of consideration by those giving attention to soil changes, that of all these 101 recorded skeletons but two or three have been preserved in anything approaching entirety.

Sherman C. Bishop

New York State Museum,
July 6, 1921

A MORE PHENOMENAL SHOOT

The July 1, number of Science records a "phenomenal shoot" which grew near Raleigh, N. C. This shoot grew from the stump of a beheaded tree of *Paulownia tomentosa* in one season to the length of 19 feet 5 inches; had twenty internodes, and was 7.75 inches in circumference at the base. This shoot is thought by Mr. Wells to be "a record for the tree type of woody plant in the temperate zone."

During the past season the writer kept track of a shoot which grew from stump of a beheaded tree of *Paulownia tomentosa*. This shoot grew during the season of 1920 to a length of 21 feet 6 inches, it has twenty-four internodes and is ten inches in circumference at the base. One of the leaves, measured in the latter part of July, was 38 inches in largest dimension. This shoot grew in clay loam soil residual from granite on property adjoining the campus of the University of North Carolina, Chapel Hill, N. C. The shoot is on exibition in the Geological Museum of the University.

W. F. Prouty

Chapel Hill, N. C.

A PHYTOPHTHORA PARASITIC ON PEONY

Early in May the writers received from Mrs. George Ray, of Erie, Pa., some blighted peonies. Since the cause of the trouble was not at once apparent, cultures were attempted from the diseased portions. These yielded at once a pure growth of *Phytophthora*. As the writers are not aware of any previous report of a *Phytophthora* as a parasite on this host, a brief description of the disease and the causal organism is here made a matter of record, pending further investigation.

Upon the original specimens, which were in fine condition when received, the disease was manifest as a necrotic condition of the bud, involving also the surrounding leaves and extending for several inches down the stem. In general appearance the symptoms are similar to those caused by *Botrytis,* although the infected areas are darker brown or black. No evidence of external fruiting of the parasite was found either upon the original specimens or upon subsequent artificially infected plants. Several attempts were made to isolate a similar organism from diseased peonies in the vicinity of State College, so far without success. Inoculations of the pure culture into healthy peonies, however, readily produced infections, and the characteristic "blighted" symptoms, from which the organism was reisolated with ease. Inoculations were made upon plants growing out doors with pure culture, using bits of mycelium and zoosporangia, and were successful both with and without wounding of the host. The characteristic symptoms appeared in from three to six days.

The *Phytophthora* in question grows readily upon a variety of artificial media, and in this respect differs from *P. infestans.* The growth is somewhat sparse upon the surface of agar slants, but is abundant beneath the surface.

It has been grown on ordinary beef peptone agar, potato agar, corn meal agar and in beef broth, where it grows luxuriantly submerged but not at the surface. Zoosporangia are produced in abundance and measure 16.7–22.3 μ x 20.4–29.7 μ. These measurements correspond closely to those for the zoosporangia of *P. infestans*[1] but are somewhat broader than those of *P. Thalictri*[2] which would appear to be its closest relative so far as hosts are concerned. Oospores have not been observed either in cultures or tissue sections.

H. W. Thurston, Jr.
C. R. Orton

Pennsylvania State College

[1] Rosenbaum, J., *Jour. Agr. Res.,* 8: 233–276. 1917.

[2] Wilson, G. W., *Bull. Torr. Club,* 34: 387–416. 1907.

QUOTATIONS

FAIR WEATHER PREDICTIONS

One fixed determination in the office of this *Journal* has been that the monthly issue shall always be ready to go into the mails on the appointed date. The staff has loyally cooperated in this effort, regardless of hours of work. With the notice given in April of an impending strike on the first of May, the matter passed beyond our hands, and when the strike materialized, the record of promptness was effectually shattered.

Fortunately for our peace of mind, the Council of the Society, representative of the membership, had agreed, by formal resolutions adopted at the Rochester Meeting, to wait indefinitely for journals, thereby materially assisting the printer in his stand against what he considered unjust demands from the striking employees.

The labor conditions affected most seriously the hand composition work in the printing office, and this force has been recruited on an open shop basis until it is now greater in number than before. Naturally, men not accustomed to printing chemical articles have had to be developed and trained, so that the new force, at first quite inefficient, is gaining steadily in efficiency. There is now every prospect that the August issue will quickly follow and that the September issue will go into the mails promptly on the last day of August. Pardon anachronisms in the editorials of the July and August issues, in view of the unusual situation.

With all of these troubles upon us, there has been one pleasurable aspect of the situation, the hearty cooperation of both authors and advertisers in the effort to get our work upon a right and permanent basis. Letters received, especially from advertisers, make us feel that there is a strong bond between this *Journal* and its patrons, and we desire here to express our sincere appreciation of that spirit.

One further word only to the authors of papers is added. The preparation of reprints requires a considerable amount of hand composition work and remaking of material. We

urge authors to be extra patient in the matter of receiving their reprints. If the present composition force is diverted to work on reprints, the issue of each of the journals of the society would be delayed to that extent. We have, therefore, taken the liberty of authorizing the printer to postpone the making up of reprints from this *Journal,* and to put all emphasis upon catching up with the regular schedule of publication. We are confident of an extension of loyal cooperation on the part of our contributors.

To adopt the language of the Weather Bureau: "For to-morrow: fair weather."—*Journal of Industrial and Engineering Chemistry.*

SPECIAL ARTICLES

NOTE ON THE USE OF THE DUBOSCQ TYPE OF COLORIMETER FOR THE DEMONSTRATION OF DIFFERENCES IN SURFACE TENSION

ALTHOUGH there are many interesting experiments by which the phenomena of surface tension can be demonstrated to students, as a rule they fail to give a basis of direct visual evidence of the main force concerned. Consequently any procedure which will enable the student to demonstrate to himself in a semi-quantitative manner, that there are differences in the ability of different liquids to sustain themselves by the forces inherent in their surfaces, should assist in an understanding of the underlying principles.

Such a demonstration can be staged by the use of the Duboscq type of colorimeter. Moreover the effects of the additions of minute amounts of various substances to water, on the surface tension of the latter can be strikingly shown.

If that point on the scale at which the dry lower surface of the plunger just comes in contact with the surface of a liquid in the cup or small beaker of about 5 cm. diameter resting upon the cup support is taken as the base line, it is possible to measure with a considerable degree of constancy the height in tenths of millimeters to which the plunger can be raised above the surface of the liquid before the clinging column of fluid breaks contact and slides back into the container. This affords a clear idea of the principle of surface tension from the fact that an obviously weighable volume of liquid is lifted and held above the main surface of fluid by the force of the liquid surface in contact with the plunger.

When a comparison is made of the height to which the plunger can be raised from contact with the surface of such substances as water, ether, absolute alcohol, acetone and toluol, it becomes at once evident that different liquids have different abilities to cling to the plunger surface and hence different surface tensions. When a bit of soap is swished around in the water in the beaker and then removed, the marked decrease in surface force is made plain by the decrease in the height to which the plunger can be raised before contact is broken. A similar result is obtained when a trace of amyl alcohol is added to the water. When a bit of picric acid is dissolved in the water in the beaker the opposite effect is observed and is of sufficient magnitude to demonstrate why picric acid solutions "bump" when heated.

TABLE

Substance	Height in 0.1 mm.	a^2mm^2
Water	40	14.68
Toluol	29	6.72
Acetone	28	6.18
Absolute alcohol	27	5.08
Ether	25	4.61
Water plus soap	36	
Water plus amyl alcohol	33	
Water plus picric acid	42	

The accompanying table shows the values obtained for the substances mentioned. The second column of figures gives the values for the same compounds as copied from Landolt, Bernstein and Roth's tables, 4th edition, in terms of a^2mm^2. The correspondence is pleasingly close, but is of course accidental since contributing factors other than the height in millimeters are obviously involved, though in this group they happen to be mutually compensating.

These few examples suggest the availability of the plunger-cup mechanism as a basis for the development of an accurately calibrated piece of apparatus for the determination of

absolute surface tension values in terms of dynes. Such an instrument with its proper formula might well be of service in such measurements because of its simplicity of manipulation.

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VARIATION OF INDIVIDUAL PIGS IN ECONOMY OF GAIN

IN a very interesting article by Ashby and Malcomson, published in the *Journal of Agricultural Research,* Volume XIX., pages 225–234, the following statement is made on page 232:

> The resultant coefficient of correlation
>
> $$r = -0.452 \pm 0.068$$
>
> shows a distinct negative correlation between rate of gain and economy of gain, entirely disproving the apparent relation shown by Tables IX. to XV.

This conclusion is very interesting, especially since it is contrary to the usual belief and usual experience. The writer has recalculated the coefficient of correlation from Table XVI. on page 232 and found a different result from that given by Ashby and Malcomson in that $r = -0.166 \pm 0.083$ which is not a significant correlation.

Thinking that a different treatment of the data might throw further light on this point, a new correlation table was made between the rate of daily gain and the amount of feed required to produce 100 pounds of gain. This correlation was found to be

$$r = +0.140 \pm 0.083.$$

This is not a significant correlation, but it is interesting to note that it is positive instead of negative.

Again Ashby and Malcomson combined cases of animals fed on pasture and of those fed in the dry lot. From a statistical point of view, this is not advisable, since the food derived from the pasture was not taken into consideration.

The average daily gain of 27 animals fed on pasture was 1.14 pounds and the average amount of feed required to produce 100 pounds of gain was 361.2 pounds. The average daily gain of 36 animals fed in the dry lot was 1.41 pounds and 391.8 pounds of feed were required to produce 100 pounds of gain. It is readily seen from these figures that the rate of gain among pasture fed animals was less than among those of the dry lot, and at the same time the amount of feed for 100 pounds of gain was less, because the part of the feed from the pasture was not taken into consideration.

Separate correlations were found for these two groups. In the pasture-fed group

$$r = -0.181 \pm 0.126,$$

while in the dry lot group

$$r = -0.036 \pm 0.112.$$

Both of these are negative but not significant. When treated together

$$r = +0.140 \pm 0.083,$$

a positive correlation but still not significant.

One can not accept the conclusion of Ashby and Malcomson that there is a negative correlation between the rate of gain and economy of gain for the following reasons:

1. On the basis of their own data, there is no significant correlation.

2. From a statistical standpoint it is not legitimate to pool cases of animals fed on pasture and animals fed in the dry lot, for the purpose of determining the correlation between rate of gain and economy of gain since the two groups are dissimilar.

Other factors which might influence the results are initial weight, age, length of feeding period and methods of feeding. In their discussion, the possibility is suggested of using these individual differences as a basis for selecting strains which are more economical producers. But these variations which they found can not be said to be genetic because of too many uncontrolled factors such as cited above. It is interesting to note that even when pigs are self-fed, selection is exercised by individual pigs in the kinds of feed which they consume. The following table taken from a preliminary report by Ashby on page 201 of the 1916 *Proceedings of the*

American Society of Animal Production illustrates this point:

PERCENTAGE COMPOSITION OF RATION

Feed	Range in Per Cent.
Corn	85.21 — 90.65
Shorts	1.53 — 4.11
Tankage	6.22 — 12.10

The method of individual feeding which Ashby and Malcomson used seems to be the only method available for the study of some of the problems of animal production and one to which more attention must be given, but there are many factors operative rendering such a method difficult.

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THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF RUBBER CHEMISTRY

W. W. Evans, *chairman.*
Arnold H. Smith, *secretary.*

The day was devoted entirely to a discussion of the tentative procedure for the analysis of rubber goods.

Reports from the executive committee, abstract committee, accelerator committee, and physical testing committee were read.

Thermal conductivity of some rubber compounds: A. A. SOMERVILLE. Rubber mixes have been made containing different amounts of sulphur, with and without accelerators, with equivalent volumes of various fillers, and given a range of cures. The thermal conductivities of these samples have been compared and the results of the test indicate a wide variation in thermal conductivities due to different fillers being used.

Contribution to the knowledge of the resins of Hevea rubber: G. STAFFORD WHITBY and J. DOLID. A number of crystalline substances have been isolated from the acetone extract of plantation Hevea rubber. At least two of these are sterols. The less soluble of the two constitutes roughly 5 per cent. of the extract, it decomposes without melting, and forms an optically active acetate crystallizing in leaflets and melting at 169°. With this sterol another substance, not yet isolated in a state of purity, was associated. The soluble sterol consisted of matted, flexible leaflets, melting at 127°. A substance, optically inactive, melting at 62°, constituting roughly 5 per cent. of the extract, was obtained. Quebrachitol was isolated from the extract, and was found to occur generally in sheet and crepe. The results of a quantitative study of the oxidation of caoutchouc under the catalytic influence of copper are reported.

The solubility of gases in rubber as affecting their permeability: CHARLES S. VENABLE and TYLER FUWA. It was found that when rubber absorbs gas, the gas is held in true solution and not by absorption. In the case of carbon dioxide, which has about an average solubility, the amount of gas thus held in true solution by the rubber is directly proportional to the pressure and decreases with increasing temperature. This solubility is unaffected by degree of vulcanization or by the presence of compounding ingredients. Other gases seem to behave in a similar manner. Relative solubility values obtained for various gases in rubber show that there is a general relationship between the solubility and density of the gas and its rate of penetration through rubber. These results, in general, confirm the original hypothesis of Graham that the penetration mechanism consists in the solution of the gas at one surface of the rubber and the diffusion of the undissolved gas through the rubber and its evaporation at the other surface. The indications are, however, that the actual size of the gas molecule is also an appreciable factor. A striking relationship between the solubility of various gases in rubber and in water has been noted.

Reactions of accelerators during vulcanization. III. Carbo-sulphydryl accelerators and the action of zinc oxide: C. W. BEDFORD and L. B. SEBRELL. Reactions of accelerators producing mercapto groups by action of sulfur are discussed. Thio carbanilide with aniline in benzol solution will dissolve zinc oxide and will vulcanize a zinc oxide cement at room temperature. Other zinc salts of mercaptans such as zinc thiophenol and zinc-ethylxanthate will vulcanize pure gum cements containing sulfur at room temperature. These accelerators are free from nitrogen or alkali and also function in press or steam cures. Without zinc oxide no accelerator has been found which will vulcanize at room temperature. Zinc salts of carbo-sulphydryl accelerators furnish the key to the paper.

The influence of piperidine-piperidyl-dithiocarbamate on vulcanization: G. STAFFORD WHITBY and O. J. WALKER. Tested in a 90 : 10 rubber-sulfur mix, 1 per cent. of the base mentioned is

found to reduce the time of cure by seven eighths, and even at 130° to lead to curing in about one third of the time required at 141° in its absence. At the optimum cure rubber containing the base showed (*a*) a noticeably lower sulfur coefficient, (*b*) a very considerably higher breaking stress, (*c*) a noticeably smaller elongation, and (*d*) a lower position of the stress-strain curve (strains as ordinates) than did rubber from which the base was absent. On aging for 7 months, vulcanizates prepared with the base behaved in a manner essentially similar to that shown by vulcanizates prepared without it; the stress-strain curves coming down the paper to a similar extent and the breaking points altering in a similar way.

A rapid bomb method for the determination of sulfur in rubber compounds: W. W. Evans and Ruth E. Merling.

The direct determination of the sulfur of vulcanization: S. Collier and Michael Levin. The sulphur actually combined with the rubber is determined by dissolving the rubber and polyprene sulphide in cymene. The solution is diluted with petroleum ether and filtered after the fillers have settled out. The filtrate containing the polyprene sulphide is evaporated to dryness by heating on the steam bath and by means of a gentle current of air. The residue is dissolved in nitric acid and the solution evaporated to dryness. Three c.c. of nitric acid are added to the residue and then 5 grams of sodium carbonate. The mixture is fused and the amount of sulphur determined.

Volume increase of compounded rubber under strain. (Lantern.) (With comments on the work of H. F. Schippel.): Henry Green.

A general round table discussion followed on the topics of factory control of vulcanization, testing of crude rubber as received at the factory, reactions between sulfur and various softeners, and others.

Division of Biological Chemistry

A. W. Dox, *chairman.*
H. B. Lewis, *secretary.*

A study of the highly unsaturated fatty acids occurring in fish oils: G. D. Beal and J. B. Brown. A proximate determination of the composition of five commercial fish oils was made by converting a kilo of each of the oils into its methyl esters by a modified Haller methanolysis, distilling these into ten-degree fractions under reduced pressure and analyzing these fractions. Evidence for the presence of myristic, palmitic and clupanodonic acids was given, and also for acids more highly unsaturated and of greater molecular weight than clupanodonic acid. When the refractive indices of the fractions were plotted against the corresponding iodine numbers and mean molecular weights of the acids, curves which were nearly straight lines were produced. The analytical data showed a decided similarity for the oils examined, which included salmon, menhaden, herring, cod and sardine oils. The pure highly unsaturated acids were prepared in more than 50 per cent. yield by reduction of their methyl ester polybromides in methyl alcohol with zinc dust. The mean molecular weight of these acids by titration was over three hundred, a value much too high for clupanodonic acid. Distillation of the methyl esters of these acids and analysis of the fractions gave good evidence for the presence of the following acids—hexadecatrienoic, $C_{16}H_{26}O_2$, clupanodonic, $C_{18}H_{28}O_2$, arachidonic, $C_{20}H_{32}O_2$, eicosapentenoic, $C_{20}H_{30}O_2$, docosapentenoic, $C_{22}H_{34}O_2$, and docosahexenoic, $C_{22}H_{32}O_2$.

Further studies on the mosaic disease of spinach: S. L. Jodidi. Mosaic disease affects many crops of vast economic importance such as the Irish potato, tobacco, corn, sugar beet, sugar cane, spinach, cabbage, lettuce, tomato, cucumber, and others. It seemed quite desirable to study the mosaic disease of at least one crop—in this case spinach—from various angles and by various methods. The results of the investigation have led to the following conclusions: (1) The physical and chemical properties of the soil taken from under diseased spinach plants were found to approach very closely those of the soil taken from under healthy plants. (2) The differences in the biological behavior of the two soils under consideration, as shown by their ability to ammonify various organic nitrogenous compounds, were so small as to be negligible. (3) The mosaic disease of spinach does not seem to be due to malnutrition, since in the experiments reported the diseased condition of the plants can not be ascribed to physical, chemical and biological conditions obtaining in the soil.

Chemical, physical and insecticidal studies of arsenicals: F. C. Cook and N. E. McIndoo.

Cysteine as a product of the intermediary metabolism of cystine: H. B. Lewis and Lucie E. Root. After the administration either orally or subcutaneously of 1-phenyluraminocystine to rabbits,

a product was isolated from the urine which has been identified as the phenyluramino derivative of cysteine.

Avian versus mammalian dietary requirements: W. D. Richardson.

The influence of fasting and of vitamine B deprivation on the non-protein nitrogen of rat's blood: H. A. Mattill. The non-protein nitrogen of the blood of fasting rats is 30–40 per cent. higher than that of normal animals, the most marked increase being in urea. Creatinine and creatine are very slightly increased as are total solids. The blood of rats deprived of vitamine B shows practically no variation from the normal except that creatinine is at the fasting level and creatine is slightly higher than the fasting figure. In the present state of uncertainty with reference to the determination of blood creatine and creatinine these variations are of little significance but at least the total solids, the non-protein nitrogen and the urea fraction in the blood of rats on a diet deprived of vitamine B are normal and not increased as in the blood of fasting rats. The desirability of obtaining information on the gaseous metabolism as well as on creatine metabolism in animals deprived of vitamine B is suggested.

The effect of temperature and the concentration of hydrogen ions upon the rate of destruction of the antiscorbutic vitamin: H. C. Sherman, V. K. LaMer and H. L. Campbell. The time curve of the destruction in filtered canned tomato juice follows neither the unimolecular nor the square root law of Schütz when the heat treatment is conducted at 60°, 80°, 100° C. for 1 to 4 hours. Empirically the destruction in these cases was found to be a function of the fourth root of the time. The temperature coefficient of the destruction of the vitamin was low: Q_{10} (60°–80°) $=1.23$; Q_{10} (80°–100°) $=1.12$. The low temperature coefficient and the colloidal nature of the material indicate that in tomato juice, at least, the reaction is of the heterogeneous type with diffusion playing an important rôle. Oxidation by oxygen can not be an important factor in these experiments. The velocity of the reaction at 1 hour at 100° C. progressively increases with decreased (H^+). The omission of reacidification following such treatment produces an even greater destruction due no doubt to the continued action of the greater (OH^-) even at low temperature.

The quantitative measurement of the antiscorbutic vitamin: H. C. Sherman, V. K. LaMer and H. L. Campbell. Guinea pigs are fed a basal diet consisting of oats 59 per cent.; skim milk powder heated 2 hours at 110° C., 30 per cent.; butter fat, 10 per cent.; NaCl, 1 per cent. In addition to the determination of the minimum protective dose of antiscorbutic the degrees of scurvy produced, as measured by the autopsy findings, retardation in growth, and symptoms in life, are determined for a series of animals receiving graduated sub-protective doses of antiscorbutic food. When the dosage is calculated per unit of body weight it is possible to distinguish the degrees of scurvy produced for addenda of antiscorbutics differing by 15 per cent. or less. The per cent. destruction due to a deleterious process is obtained by comparison of the degree of scurvy produced in a series of standard animals fed a similarly graduated series of doses of the treated product. The probable error of the mean in a series of 5 or more animals is less than 4 per cent.

The action of nitrous acid on casein: Max S. Dunn and H. B. Lewis. Deaminized casein has been prepared by the action of nitrous acid on casein. Analysis by the Van Slyke method for free amino nitrogen showed the absence of free amino nitrogen. Casein and deaminized casein were hydrolyzed and analyzed by Van Slyke's procedure for the determination of characteristic groups. In harmony with the current theories as to the nature of the free amino groups of the protein molecule, lysine was found to be absent in deaminized casein. No other notable differences were detected between casein and deaminized casein. Tyrosine was determined by the Folin-Denis colorimetric method. Deaminized casein was found to contain a lower percentage of tyrosine than casein.

Lipase studies. The hydrolysis of the esters of some dicarboxylic acids by the lipase of the liver: A. A. Christman and H. B. Lewis. On the basis of the acidity developed when the lipase of hog liver was allowed to act on the diethyl esters of succinic and malonic acids, it is considered that the reaction proceeded to an equilibrum which corresponded to the removal of one ethyl group from the diethyl esters. A substance was obtained from the products of the reaction between diethyl malonate and lipase which gave on analysis figures which were in good agreement with those required for monoethyl malonate. Lipase of hog liver was not able to hydrolyze monoethyl malonate or potassium ethyl malonate.

Vitamines in milk: (By title.) H. Steenbock, Mariana T. Sell and E. M. Nelson. The writers have been able to substantiate Osborne and Mendel's findings that at least 15 c.c. of milk are required daily to cover a young rat's requirements for the water soluble vitamine. Generally speaking, milk can not then be considered a good source of either the water soluble vitamine or the antiscorbutic vitamine, as our previous investigations and those of others have already shown. This conclusion is emphasized by the fact that it has now been found that approximately 2 c.c. of milk are necessary to furnish a sufficiency of the fat soluble vitamine, which shows that milk fully equals in value, with one exception, our best known sources of this dietary constituent. This figure can not be taken as absolute, however, for even under practical farm conditions a many fold variation in fat soluble vitamine content easily obtains as the ration of the cow changes. Sudden variations in vitamine content are probably in large part prevented by drainage of the storage reservoirs of the animal. Liver tissue for one has been found to depreciate in fat soluble vitamine content on a fat soluble vitamine poor diet. Yet in the aggregate even this effect can not be very prolonged.

Further experiments on the isolation of the antineuritic vitamine: Atherton Seidell. In a previous paper (Public Health Reports, April 1, 1921) it was shown by control tests on pigeons that the precipitate obtained by addition of ammoniacal silver nitrate to a purified vitamine extract made from yeast "activated" fuller's earth is highly antineuritic. This vitamine silver complex is amorphous and its conversion to a crystalline condition has not been effected. Attention has, therefore, been directed towards the preparation of crystalline derivatives of the active constituent of the compound. Among those which have been obtained are the picrate, nitrate and what appears to be the free base. Of these, the picrate does not give a constant melting point and yields picric acid by ether extraction. The nitrate melts with decomposition at 146°. The base is very slightly soluble in strong alcohol but so soluble in water that a viscous pellicle is usually obtained on slow evaporation of the aqueous solution. The physiological testing of these products has not been completed.

The occurrence in the animal organism of two types of lipases: Victor E. Levine and Francis J. McDonough. Lipase was found in all the organs of the pig that have thus far been examined. By the action of bile or bile salts (sodium glycocholate and sodium taurocholate), the lipolytic enzyme may be differentiated into two types: α-lipase and β-lipase. The former is observed only in the pancreas or in its secretions. Its activity is accelerated by bile or bile salts and by heated blood serum. The latter is found in all the other tissues tested. Its activity is also accelerated by serum, but is markedly inhibited by bile or bile salts. The contrasting effect of bile salts therefore serves to distinguish the exo-lipase of the pancreas from the endo-lipase of all other organs. In the light of these experimental results Cohnheim's contention, that no difference exists between an exo-enzyme and its corresponding endoenzyme, is untenable. In view of the similarity in the action of serum upon α-lipase and upon β-lipase it is probable that the two types possess the same groupings or chemical nuclei in their molecular structure. The dissimilarity in the effect of bile salts may be the result of tautomeric modification, or may indicate a difference in stereoisomeric configuration or a variation in the side chains or substituents in the major groupings of the enzyme molecule.

The distribution of lipolytic activity in the kidney: Victor E. Levine and Salver A. Gianelli. Studies were made of the lipolytic activity of the kidney of the rabbit, dog, sheep, pig and cow. The source of enzyme was a chloroform-water extract of the anatomical regions of the kidney, cortex, upper medulla and lower medulla (papillary portion). Ethyl acetate, ethyl butyrate, methyl salicylate, olive oil and castor oil served as zymolytes or substrates. Quantities of extract equivalent to 80 mgs. of tissue were employed, and the lipolytic activity determined by titration, in the presence of phenolphthalein, with N/25 or N/50 sodium hydroxide. When olive oil or castor oil was used, titrations were made after the addition of alcohol. The two kidneys in the same animal always show a distinct variation in lipolytic activity. The greatest lipolysis is regularly observed in the cortex, the least in the lower portion of the medulla (papillary region). The relative extent of lipolytic activity corresponds to the relative distribution of fat in the kidney as recently reported by Christianna Smith (*Amer. Jour. Anat.*, 1920, 27, 69). This distribution in accordance with the anatomical divisions of the kidney explains the preponderating occurrence of fat in the cortex under normal conditions

and also under those of fatty degeneration. The large number of contradictory findings concerning the presence or absence of enzymes in the kidney and the inability of investigators to find normals for this tissue rest upon the failure on their part to consider the kidney with reference to its anatomical regions.

Uric acid and phenols in the saliva: M. X. Sullivan and Paul R. Dawson. Salivas collected in 30 minutes under stimulus of chewing paraffin were freed from protein by treatment with 10 per cent. trichloracetic acid followed by 10 per cent. sodium tungstate in 2/3 N H_2SO_4 and were then tested for uric acid and phenol. The uric acid precipitated by silver lactate in 5 per cent. lactic acid, after appropriate treatment, was estimated colorimetrically. The phenols in the filtrate from silver urate, after appropriate treatment, were estimated colorimetrically with resorcinol as standard. Both uric acid (urates) and phenols (free and conjugated) were found in normal saliva and in the saliva of pellagra patients.

Extraction and estimation of lipoids in cereal products: O. S. Rask and I. K. Phelps. Ether extracts from cereal products, raw or cooked, do not represent their total lipoid content (fatty matter). A preliminary treatment of such products by an ammoniacal alcohol solution and a subsequent extraction by a mixture of ethyl ether and petroleum ethers in a manner similar to that specified in the Roese-Gotlieb method for fat in milk, yields higher results which appear to represent more nearly the true lipoid content of cereal products. Ether extracts of uncooked cereal products represent on the average 65 to 70 per cent. of the results obtained by the above procedure.

Estimation of phospholipins in cereal products: O. S. Rask and I. K. Phelps. A further study of the lipoids referred to in the preceding abstract indicates that they contain all phospholipins present in cereal products and the lipoid phosphorus of cereals may be estimated by determining the phosphorus content of their lipoids thus obtained.

Resemblance of the thermal death point of bacteria to chemical reaction: W. D. Bigelow. The data presented by W. D. Bigelow and J. R. Baty in the *Journal of Infectious Diseases* for December, 1920, can be expressed in the form of semilog curves which are straight lines between the temperatures of 105° and 125° C. At higher temperatures the experimental evidence is inconclusive because of error produced by the time required for heat to penetrate to the center of the tubes. For this reason the time secured by extending the semilog curves mentioned above is more nearly correct than the experimental data for temperatures above 125° C. At temperatures below 105° C. the time necessary for the destruction of spores appears to be less than would be indicated by an extension of the semilog curves. The semilog curves showing the thermal death point of spores of the fifteen bacteria referred to are all parallel to each other. It is suggested that if other spores follow the same law the position of the curve showing the time necessary to destroy the spores at various temperatures is fixed by the determination of the time at one temperature. It is suggested that the thermal death point of non-spore-bearing bacteria at different temperatures will probably follow the same law or a similar law.

The intensity of light necessary to initiate a photochemical change in the retina: E. L. Chaffee and W. T. Bovie. This investigation concerns the potential differences which are set up in the retina when it is illuminated. An apparatus is described in which the differences in potential are amplified by audions through stages. An Einthoven galvanometer is used. The changes are recorded photographically. A single exposure gives three distinct deflections. It was shown as a new contribution that these deflections are greatly influenced by experimental conditions, such as the length of time which has elapsed since the eye has been excised. Over a range of intensities which are very close to the threshold for human vision the height of the first deflection is proportional to the amplitude of the light vibration.

An "antidote" for a "poisoned electrode": W. T. Bovie.

Abiotic action of rays due to ozone and the heat sensitization of protoplasm by ultra-violet light: W. T. Bovie. The experiments concern the processes which take place in *Paramecium caudatum* during the time between the exposure to fluorite rays and the appearance of the first visible effects of the radiation; that is, during the so-called "latent period." The latent period is shorter and the effects of the rays are more intense the higher the temperature to which the organism is raised and the longer the time the organism is maintained at the higher temperature. No similar effects are observed if the organism is subjected to the increased temperature immediately before the radiation instead of after it.

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Secretary

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THE SPIRIT OF INVESTIGATION IN MEDICINE[1]

THE first Greek poet of whose personality we are certain, Arctinus of Lesbos (B.C. 770), sharply differentiated medicine and surgery, and held medicine responsible for the advancement of medical science. He relates how Esculapius "endowed one of his sons with nobler gifts than the other; for while to the one, Machaon, he gave skilled hands to draw out darts, make incisions and heal sores and wounds, he placed in the heart of the other, Podilarius, all cunning to find out things invisible and cure that which healed not." How can we, disciples of Podilarius, best proceed in this day and generation to "find out things invisible and cure that which heals not"?

The problem is as old as medicine itself The story of medical investigation unfolds itself in the history of medicine. Progress comes through ideas. Great investigators have appeared from time to time in medicine. They have contributed new ideas, in the elaboration of which they recorded new observations, recognized new facts, established laws, advanced the art of practise, and thus developed the science of medicine. As time passed the so-called underlying or fundamental sciences evolved, and in turn made fresh opportunities for the medical investigator, but they have taken a large proportion of medical investigators from the field of active practise. Some are still left who are attempting to "find out things invisible" and to solve the ever-present problems of treatment of the sick.

Recently, to further such ends, a national Society for Clinical Investigation was created (1909). According to the constitution the objects of this society are "the cultivation

[1] From The Mayo Foundation, Rochester, Minnesota. President's address before The American Society for Clinical Investigation. May 9, 1921.

of clinical research by the methods of the natural sciences, the unification of science and the practise of medicine, the encouragement of scientific investigation by the practitioners, and the diffusion of a scientific spirit among its members." Broadly speaking, these simmer down to the better care of the sick, the broadening of the bounds of medicine, and the development of the physician himself.

To the public generally, medical investigation makes no great appeal. The research worker is commonly regarded as impractical. Yet the routine practise of to-day is based on the investigation of yesterday. Wassermann tests, renal functional tests, and spinal fluid findings constitute substantial phases of the medical practise of to-day. Yet, we did not have them fifteen years ago. The public and many physicians fail to appreciate that practise is based on investigation, and that clinical investigation means better care of the sick, greater public health, and happier communities.

Investigation is complex. It demands certain mental attributes. The most essential is a veritable lust for truth. This has to be supported by skill in experimentation, accuracy in observation and record, correct interpretation of findings, and due appreciation of their significance. The lust for truth must result in active search which recognizes no sacrifice. Skill in experimentation involves insight and ability in the selection and the carrying out of well-controlled experiments. Accuracy in observation implies capacity to see, a knowledge of the subject, and an appreciation of the phenomena observed. Accuracy of record demands precise and prompt notations, made preferably during the course of experimentation, for, as a rule, observations made to-day and recorded tomorrow are lost to science. Correct interpretations of findings and due appreciation of their significance demand a well-trained mind, critical judgment, and a familiarity with the subject in relation to contemporary science.

This may be stated in a somewhat different way. Investigation consists of four fundamental factors: (1) the clear conception of the problem, that is, a definite "Fragestellung"; (2) the selection or development of methods capable of solving the problem; (3) ability to recognize relationships, to orient the problem to existing facts; and (4) accurate measurements and records.

The spirit of investigation is a living force, born within or rendered kinetic by contact from without, which, when first awakened, is usually feeble and requires cultivation, but when fully developed directs action and controls destiny. It is difficult to define, to understand, to acquire, to cultivate, and to communicate.

The cultivation and the diffusion of the spirit are our problems. Once the investigator is imbued with the spirit, investigations will proceed and bring results. But in diffusing, the spirit must be communicated so that it may be acquired by another. Consequently we must consider its acquisition as well as its cultivation and diffusion.

Acquisition of the Spirit of Investigation.—The statements of Hippocrates relative to the attributes desirable in the student for instruction in medicine apply equally well to the prospective investigator. Hippocrates says:

> Whoever is to acquire a competent knowledge of medicine ought to be possessed of the following advantages: a natural disposition, instruction, a favorable position for the study, early tuition, love of labor, leisure. First of all, a natural talent is required, for when nature opposes everything else is vain, but when nature leads the way to what is most excellent, instruction in the art takes place, which the student must try to appropriate to himself by reflection, becoming an early pupil in a place well adapted for instruction. He must also bring to the task a love of labor and perseverance, so that instruction taking root may bring forth proper and abundant fruit.
>
> Instruction in medicine is like the culture of the production of the earth, for our natural disposition is, as it were, the soil; the tenets of our teacher are, as it were, the seed; instruction in youth is like the planting of the seed in the ground at the proper season; the place where the instruction is communicated is like the food imparted to vegetables by the atmosphere; diligent study is like the cultivation of the fields; and it is time

which imparts strength to all things and brings them to maturity.

But we need not concern ourselves unduly about the extent and character of the soil. Every year brings into medicine thousands of young men—"good ground" capable of bringing forth fruit, "some thirty, some sixty and some an hundred fold." To be sure, we must participate in the cultivation of the soil, but to the planting of the seed in the ground at the proper season we must first direct our efforts.

The present season is unusually favorable. Formerly much of the sowing and early cultivation among Americans was done abroad. Since this is no longer possible, the responsibility is clearly ours. Never in the history of American medicine has the responsibility been heavier, the opportunity greater. Seed time in medical life rarely lasts more than ten years. It is represented by years in the medical school and those immediately following graduation. In the undergraduate years, intensive cultivation, as a rule, preempts the field and permits sowing and cultivation, but rarely harvesting. Unless fruit is brought forth within five years of graduation it is rarely forthcoming. In this crucial period of growth there are in this country at the present time probably a thousand young men properly seeded, but in need of cultivation. In this period environment is all important and includes subsidiary factors necessary to production, such as time, space, facilities for work, inspiration, guidance, criticism, advice, and access to literature. Growth at this period is, as a rule, not sufficiently advanced to permit the investigator to control these factors personally. The responsibility rests, therefore, upon the sowers.

Some of these factors are supplied by the creation of the so-called "atmosphere." Our greatest need in medicine is institutions with atmosphere. All of us who have worked in certain medical centers have recognized the existence of atmosphere and have felt its influence. It results from the reciprocal stimulation of many capable workers in diversified fields. It constitutes, as it were, a high tension center capable of furnishing inspiration to many.

The Cultivation of the Spirit—Work.—Osler's masterword in medicine is also the masterword in investigation. Every member of this society should possess the spirit, and is pledged to its diffusion. This means always more work. American medicine looks to the members of this organization for leadership in clinical investigation. It is self-evident that real leadership can not be exercised with work that is finished. Only he who continues to work continues to lead.

Great efforts have been put forth in this country during the last decade to do away with the old system whereby the energies of so many clinical investigators of merit are diverted into other fields. A man capable of high-grade investigation should not be converted into a routine teacher, administrator, or practitioner solely. For it can not be too strongly emphasized that capable investigators are more rare than good administrators, and a first class teacher must be an investigator.

The medical way is but a succession of decisions. The successful investigator faces continuously the situation described by William James. In one of his letters he says,

> I stand at the place where the road forks. One branch leads to material comfort, the flesh pots, but it seems a kind of selling of one's soul; the other to mental dignity and independance, combined, however, with physical penury. On one side is science, on the other business.

The further the medical road is successfully travelled, the more enticing are the by-paths leading from investigation, and they need not all be paved with gold. The sign posts carry such inscriptions as "deanship," "professor," "director," or "chief." These signs on the medical way are dangerous, and ofttimes deceive the very elect, especially if the elect be hampered with physical penury or blessed with a large family. Despite position failure to continue to investigate leads to loss of those attributes necessary for leadership. Neither position nor worldly possessions should insure leadership in medicine. Work is the masterword, work in the class-room, laboratory,

ward, and office. Investigation can not be done solely from the office desk nor from over the tea cups.

Science rests on investigation, and investigation is measuring. With the modicum of science at his disposal, the busy practitioner is not equipped mentally, nor has he the time nor the technical facilities necessary to deal with the more complex problems of disease. The investigator must needs keep pace with contemporary science, in itself a big undertaking, and must apply it to medical problems as opportunity arises or can be created. As Galileo was engaged in the creation of the sciences of physics and mathematics, Sanctorius through his assistance was engaged in applying the thermometer and balance, that is, the new instruments of science, to the problems of physiology. This is as it should be. In these days physiologists and physiologic chemists at times intervene, but some times as liaison officers only, between the clinician and pure scientists. The field in medicine for the pure scientist is still great, despite the splendid contributions to medicine which constantly pour forth from the laboratory workers in the fundamental branches of medicine. Closer and more direct points of contact are desirable, more direct intercourse, in order that the problem, as seen by the physician, may be placed first-hand and in its true light before the pure scientists.

Diffusion of the Spirit.—There are at present in this country a relatively large number of young men capable of developing into investigators. This society has approximately 150 members, all of whom are obligated to the diffusion of its principles. As a society, to my mind, we are not even approaching the possibilities in diffusing the love of investigation among the younger men.

Membership in this society entails responsibilities. Eligibility for membership is simple. Any practising physician in the United States who has accomplished a meritorious, original investigation and who enjoys an unimpeachable standing in the profession is eligible. But once a member, the responsibility of a leader is assumed, since one of the obligations imposed upon its members by this society is to be "active in the diffusion of the principles of this society."

This is a national organization comprizing members from every part of the country. It meets once a year and presents and listens to twenty-five papers. Many younger men are scattered throughout the country who have no access except through abstracts to the proceedings of this society. The founder of this society recognized this truth. He met the situation, however, in his own locality by founding the Society of Experimental Biology and Medicine in New York City with a constitution embodying principles identical with ours. The local society functions locally and attempts to accomplish locally what we are attempting nationally. It meets frequently, whereas we meet annually. It reaches those who need its influence most.

As president of this society I wish to suggest that we consider and adopt some plan whereby we can be more effective in the cultivation of the spirit of investigation. It might be wise to follow the example of Dr. Meltzer and create subsidiary, local societies of clinical investigation in various medical centers throughout the country, societies which would carry some sort of affiliation with the national society.

How could such a plan be carried out in Boston, for instance? At the present time each institution entering into consideration has, in all probability, its own society intended for the cultivation of the spirit. Without disturbing their present organization or function, it would be possible to hold joint sessions once a month in the various institutions, as the Boston Society for Clinical Investigation. Such an organization would afford each Boston member an opportunity to attend, to bring with him his young associates and to meet those of the others, and to diffuse and instil the spirit into the entire group. On a small scale such an organization would afford the beginner the same opportunities and advantages enjoyed by us through membership in this society. By holding the meetings in the various institutions, each beginner would be afforded an op-

portunity to acquaint himself with other institutions and their staffs, such advantages as some of us on a larger scale have enjoyed through membership in the Interurban Clinical Clubs. From the local programs could be selected the best material for presentation before the national society. From the local society could be selected those most fit for full membership in this organization. Thus, without necessarily increasing the number of meetings, through the organization of subsidiary, local societies, the spirit of investigation could be better cultivated among those whose need is greatest. Since the aims are identical, the advantages accruing to the members of the local organization are obvious, but whether their relation to us should be official or unofficial is for us to decide.

Dr. Meltzer, the founder of this society and the prototype of the clinical investigator, recognized very clearly the need of encouraging younger men in their investigative aspirations. We could not do greater honor to his memory than to follow his example and create local centers fostering clinical investigation.

Leonard G. Rowntree

The Mayo Clinic

OBSERVATIONS OF THE AURORA AT THE LOWELL OBSERVATORY MAY 14, 1921

The very brilliant auroral display which appeared on May 14 exhibited frequently the phenomenon of streamers diverging from a definite point in the heavens, and it was often possible to locate this radiant, with reference to the stars, with considerable accuracy. The resulting positions, with the times of observation, are as follows:

Mountain Time	Hour Angle	Declination
8^h 54^m	$+47^m$	$+4°.5$
8 56	+39	+3 .6
9 00	+39	+4 .4
9 01	+44	+4 .4
9 04	+30	+3 .7
9 06	+34	+3 .1
9 13	+39	+3 .7
9 16	+38	+2 .6
9 19	+40	+3 .0
9 20	+37	+2 .7
9 24	+31	+2 .2
.. ..	....	.....
10 49	+21	+2 .3
10 55	+31	+2 .8
11 02	+26	+3 .8

Jupiter, Saturn and β Virginis served as comparison stars for the earlier observations and ζ Virginis for the last three. The means of the first eleven estimates and of the last three, give:

Mountain Time	Hour Angle	Declination	Altitude	Azimuth
9^h 08^m	$+38^m$	$+3°.4$	$57°.2$	S 17°.4 W.
10 55	+26	+3 .0	57 .4	S 12 .1 W.

The average deviation of a single observation from the mean is $\pm 0°.7$ in declination and $\pm 3^m.5$ in hour angle, so that the difference between the two positions appears to be real.

The mean of the two, giving the first double weight, places the radiant in altitude 57°.3, azimuth S 15°.6 W. The magnetic dip at Flagstaff is 62° and the variation 15° E. so that the radiant was very nearly on the magnetic meridian but about 5° south of the "magnetic zenith."

The aurora was not only very bright, in spite of the light of the half moon, but extended surprisingly far south. About 9 P.M. several bright patches were seen low in the south, and at 11 the whole southern sky was full of streamers and patches of light.

At 10:57 a remarkable group of short curved streamers appeared surrounding the radiant. These were but a few degrees in length, but very bright, and a distinct motion of the luminosity along the streamers was visible,—outward in all directions from the radiant, and with a curvature in a counter-clockwise direction. The motion was rapid, covering the length of the visible streamers in less than a second, and the impression was strong that what was seen was the actual motion of the particles which enter the atmosphere and cause the luminescence.

Henry Norris Russell

May 16, 1921

During the last twenty years I have known of bright auroral displays being observed in Arizona on only a few occasions. One of these was on June 15, 1915, another one on March 22, 1920, and a third on the 14th of the present May. The first and the third of these were observed at the Lowell Observatory, but not the second one as it came during unfavorable observing weather at Flagstaff. Of the two I observed, that of May 14 was much the more brilliant and wonderful (and this doubtless was also a finer display than that of March 22, 1920). It was recognized about 8:30 o'clock, and rapidly increased in brightness, soon displaying streamers and bright and dark cloud masses with the curtain or drapery features. These continued bright for some time and then in more or less subdued intensity during about an hour when the northern sky began again to show the arch and drapery effects rising and it was soon evident that another outburst was developing. This one then also progressed rapidly and at its height near eleven o'clock it was even more remarkable than the first.

The rays (for convergence of these see observations of Dr. Russell and Mr. Lampland given herewith) and the cloud forms were present in all parts of the sky at eleven o'clock. Some of these in the southern sky attracted my attention particularly by undergoing striking fluctuations in brightness. These would be bright for a few minutes, would then fade nearly or quite to invisibility, brighten again and fade, repeatedly, in the same position. There were a few small ordinary vapor clouds scattered low in the east and northeast and one or two in the southwest, which as reference objects brought out clearly the very different and fleeting behavior of the auroral clouds, both the luminous and the dark, which impressed me as being the remnants of the dismembered arch and draperies that spread over the whole sky. The spreading of the auroral canopy southward over the sky was most striking as it swung forward through the east and the west. The color displayed was most noticeable in the northwest where a red tone usually prevailed and was at times quite strong. A less intense red tint was sometimes very evident in the northeast. I did not see the blue tones sometimes reported for northern auroral displays. The most of the light was of the intermediate colors, silver with more or less greenish yellow, the silvery tone being noticeable for the higher streamers and the green and yellow tones increasing somewhat with the zenith distance, and particularly was the northern sky generally yellow with some green and less often some red tones.

My efforts were directed toward getting spectrographic observations of the aurora. Unfortunately no properly adjusted spectrograph was in readiness, but owing to the length of the display two slit spectrographs could be set up and three useful spectrograms secured. Two of these were with a single prism and a three and a quarter inch focus camera, and the third with a very dense prism and a 15 inch focus camera. The first of the small scale spectra on an isochromatic plate, is the stronger and shows about fifteen lines and band heads between $\lambda\,3800$ and the chief aurora line at $\lambda\,5578.0$. Those near $\lambda\,3914$ and $\lambda\,4276$ were especially strong and appeared to be the less refrangible edges of flutings (band heads)—this is probably also true of the radiation near $\lambda\,4650$. The other small scale spectrum, on Ilford Panchromatic plate, shows the stronger of these lines, including the line $\lambda\,5578$ and a line in the red whose wave-length according to my preliminary measures is near $\lambda\,6320$.

The negative made with the higher dispersion instrument, on Ilford red plate, records only faintly the chief aurora line, measures of which give the wave-length as 5577.8. This is in satisfactory agreement with the value 5578.05, which I found some years ago for this line from higher dispersion plates exposed to the permanent auroral light of the sky. This observation is of interest in that it leaves no further doubt that the wave-length is the same, within the errors of observation, whether the auroral light is that permanently scattered over the sky or is that of a violent storm display. The red line $\lambda\,6320$ had been previously observed visually but this is I be-

lieve the first time it has been photographed and the negative should furnish much the more accurate determination of its wave-length.

V. M. Slipher

Lowell Observatory,
Flagstaff, Arizona,
May 20, 1921

The magnificent auroral display seen at the Lowell Observatory on the evening and night of May 14 was of much interest to observers in a latitude so far south on account of the great brilliancy and diversity of types of many of the formations and their widespread distribution over the sky. The auroral light was first recognized about 8:25, or a little earlier, before twilight had disappeared. The lower sky was then very brilliant in the north and particularly in the northeast, and the characteristic greenish auroral color was predominant but over parts of the active areas a suffused ruddy glow was conspicuous, especially in the northeast. Almost immediately streamers made their appearance in the north and northeast. Ten or fifteen minutes later the display developed into great activity. Long brilliant streamers were reaching up towards the zenith and beyond, and at the same time occurred in various parts of the sky, but especially in the east and west, brilliant patches, and masses of light suggesting unevenly illuminated cloud forms as when cumulus masses are lighted on one side with the great bulk of the cloud thrown into relief by the parts that are more feebly illuminated or in the shadow. One was inclined at first to attribute these massive forms, the darker parts barely perceptible against the background of the sky, as being partially due to atmospheric clouds. But their auroral origin soon became evident. The entire formation vanished when the auroral activity in that region ceased, and also, with some attention, it was possible to distinguish the few inconspicuous ordinary atmospheric clouds present. Several of the brilliant patches persisted in nearly the same position for some time, fading out and brightening up again repeatedly.

The greatest activity of the second outburst occurred between the hours of 10 and 11. Auroral formations were at that time visible in practically all parts of the sky, exhibiting simultaneously streamers, luminous masses, and bright patches, and all undergoing incessant change. Streamers from every direction were playing across the heavens, the great beams of light gradually becoming narrower on approaching the region of convergence.

The activity in the region near the convergent was at times quite remarkable. The transformations were complex and rapid, the luminous detail flaring up and fading out in almost the twinkling of an eye in some instances. About 10:46 occurred a very striking display in this area when detail formed and dissolved at an extremely rapid rate, structure appearing in momentary flashes and at one time suggesting the fragments of a partially formed crown.

The term "convergent" will be used in connection with the phenomena of the streamers, as I had frequently the impression that the streamers from different directions *did not radiate* from the region of their concurrence but in many cases took a perceptible interval in rising from the lower parts of the sky to the point in question, gradually approaching it in a series of intermittent or pulsating advances. Doubtless the apparent configuration is a matter of perspective as in the case of meteor paths. The streamers descending along the lines of force of the earth's magnetic field are for any locality nearly parallel and the vanishing point—the point where the streamers appear to meet—would be the highest altitude at which the streamers become visible. Strictly speaking, it might be more definite to use the term radiant as understood for meteors.

The writer made several estimates of the convergent of the streamers but he missed many opportunities for additional estimates as well as for observing and recording numerous other phenomena in attempting to photograph the streamers in the region of their concurrence. At this point, or small area, the streamers were much of the time comparatively faint

and never long at rest, and when momentarily a favorable formation developed the intensity fell off too rapidly to give suitable photographs for accurate determination of the convergent. At times the convergent could be readily determined when streamers from many different directions were nearly or actually concurrent and the position of this point could be located with reference to comparison stars. My own observations were as follows:

M. S. T.		H. A.		Dec.	Azimuth	Altitude
h.	m.	h.	m.	°	°	°
9	10	0	36	3.6	16.8	57.3
9	14	0	36	2.8	16.6	56.5
9	16	0	36	2.8	16.5	56.5
9	19	0	45	3.0	20.3	56.2
9	22	0	38	2.2	17.2	55.8
		0				
10	50	0	22	—0.2	9.4	54.2
10	52	0	21	+3.7	10.0	58.1
11	25	0	30	+1.9	13.5	56.0

These observations, and also Dr. Russell's, show that generally the point of convergence was near the magnetic meridian but between 5° and 6° south of the "magnetic zenith" (coordinates of the magnetic zenith for Flagstaff are: azimuth S. 15° W.; altitude 62°). If the auroral streamers follow the lines of force of the earth's magnetic field the higher parts of the streamers might be expected to show a deflection in the direction indicated but no calculations have been made to see if the magnitude of the apparent displacement might be of the order observed. What the effect of parallax may be is also a point not to be overlooked. There can be little doubt but that the point of convergence was subject to greater actual variation in azimuth than altitude. In the magnetic disturbances that accompany auroras it is possible that changes in the earth's magnetic field might be perceptible in the course of the auroral streamers.

At 10:44 a series of parallel streamers, coming into view almost directly overhead and extending east and west, were seen drifting very rapidly towards the north, with undulating and flickering motions flowing lengthwise through them. They were visible for only a moment, the detail dissolving a short distance north of the zenith, and one had the impression that the phenomena taking place were comparatively near.

Streamers of both narrow and broad (at times somewhat diffuse) types were present. As a rule a greenish tint was most prominent in both the streamers and the extensive luminous areas but a pinkish or ruddy color was also much in evidence. At various times pinkish or pale red streamers were seen, generally in the northeast or northwest. A broad pinkish streamer in the northwest appeared to be rather quiescent and remained visible much longer than any of the other streamers during the display. It was 3° or more in width, extending perpendicularly upward from the horizon about thirty degrees. About 12:35 a superb display of both pinkish and green streamers was visible for a few minutes in the northeast, extending up about 45° from the horizon, considerably inclined southward. Throughout the display streamers of greatly varying intensity playing upward from the northern horizon were visible but these were not as conspicuous as might have been expected in view of the brightness and activity of the auroral light in other parts of the sky. Occasionally these streamers were subject to marked flickering, and some movement—a slow lateral drift. Now and then dark lanes occurred between the streamers, and in one instance a very conspicuous dark rift had a leisurely motion eastward.

From the time the auroral light was first made out in the waning twilight it was strong, with greatly increased intensity during the intervals of the outbursts mentioned, until after 1 o'clock when it rapidly subsided into a feeble glow along the northern horizon. It was reported by someone stationed at a sheep camp north of the San Francisco Peaks that another outburst of streamers developed later in the night.

The auroral light must have been of great intensity as the display was a magnificent spectacle even when dimmed with the light of the moon near the first quarter.

On the day following the display two spots

of considerable size were seen on the solar surface not far from the center of the disk.

C. O. LAMPLAND
LOWELL OBSERVATORY,
FLAGSTAFF, ARIZONA

SCIENTIFIC EVENTS

THE PRODUCTION OF FIXED NITROGEN

THE final report of the Nitrogen Products Committee of the British Ministry of Munitions, issued early in 1920, has been supplemented by a series of statistical tables relating to nitrogen fixation, now publlished by the Stationery Office, covering the latter part of the war and the period that has elapsed since its termination. This additional information has been compiled by Dr. J. A. Harker, formerly director of the Nitrogen Research Laboratory, for the Department of Scientific and Industrial Research.

Among other things, the statistics deal with the world's resources in nitrogen products, the Chile nitrate industry, the production of nitric acid and sulphate of ammonia, the synthetic ammonia process during the war, and the cyanamide industry. It is estimated that the world's capacity for the production of fixed nitrogen amounted last year to 1,561,000 tons, of which about 57 per cent. was attributable to natural sources, such as Chile nitrate and the by-product industry, and the remainder to artificial fixation processes.

The London *Times,* from which we take this information, says:

The most striking, and in some ways the most disquieting, feature of the statistical supplement to the Nitrogen Products Committee's report (mentioned in *The Times* of yesterday) is the great increase in the world production of fixed nitrogen, and of the fact that of the 50 plants in operation throughout the world, not one is established in this country and only two are to be found within the Empire. Canada has one arc process plant with a maximum capacity of 800 metric tons a year and a cyanamide process plant estimated to be capable of 12,000 tons. Thus, of the world's total estimated capacity for 1920 of 671,300 tons, the British Empire commands only 12,800 tons.

A fuller examination of the position reveals the conclusive predominance of Germany in this field. While Norway outdistances all rivals in the arc process, producing 30,000 tons out of a total of 38,300, Germany, taking the three processes together, produces nearly twice as much fixed nitrogen as the rest of the world. Of the 325,000 tons credited to the cyanamide process, Germany commands 120,000, while under the synthetic ammonia process she has a capacity of 300,000 tons, and the only rival is the United States, with the almost negligible figure of 8,000. Put in a sentence, Germany can produce by fixation processes 424,000 metric tons of nitrogen a year, and the rest of the world can produce only 237,000 tons, of which this country produces none.

Our one internal source of fixed nitrogen is therefore by-product works, and even there we produce only 100,000 tons against Germany's 150,000. As a net result our internal resources —that is, the resources on which we should have to rely if all colonial and foreign supplies were cut off—represent 2,240 tons of fixed nitrogen per million of population, while Germany's resources amount to 8,830 per million of her population. It is sometimes suggested that our inaction in this field may yet prove of advantage, since by waiting until experiment had demonstrated the best process, we might adopt it and then pick up our competitors. The history, however, of our loss of the synthetic dyestuff industry, which began in 1856 with Perkin's discovery of mauvine and still flourished for 20 years after, gives little support to this complacent theory.

The plain truth is that while other countries, especially Germany, have carried their experimental work well into the productive and commercial stage, we are still engaged in constructing plants and debating the merits of the processes of German, French, and other chemists. The synthetic ammonia factory at Billingham, designed to manufacture about 60,000 tons of ammonia nitrate annually for war purposes, was begun by the Ministry of Munitions early in 1918, but at the time of the Armistice was only very little advanced. This is now being redesigned by Brunner, Mond and Co., to manufacture fertilizers, and a subsidiary company is at present concentrating upon designs for an initial plant to produce 25 tons of nitrogen per day or about 6,000 to 7,000 tons annually. Cumberland Coal Power and Chemicals, Limited, have purchased the British rights in the French process by Georges Claude, and the British Cyanides Company are continuing at Birmingham their large-scale experiments on fixa-

tion of nitrogen by the barium process. The fact remains, however, that we are still in the constructional or experimental stage, while Germany far outdistances all competitors in actual production.

FORESTRY LEGISLATION

The Forest Service, United States Department of Agriculture, reports that no less than thirty-three states have now provided for some sort of forestry activities and twenty-five of these share in the federal cooperative forest protection fund, allotted to states maintaining an effective fire detection and suppression system.

Two others have applied recently for such assistance. Public backing of the movement to preserve the remaining forests from destruction by fire, and to put idle forest lands to work growing trees, is becoming widespread, and the effects of the popular demand for action is shown clearly in the state laws passed this year.

Pennsylvania, under the direction of Gifford Pinchot, the new commissioner of forestry, leads all states in forest activities. The biennial appropriation passed by the legislature and approved by the governor carried $1,870,000, an increase of $863,300 over the appropriation of 1919; $1,000,000 of the total is for fire protection. The legislature also passed an act empowering the federal government to acquire lands on the watersheds of navigable streams within the state, by purchase or condemnation, and to control and regulate such reserves.

The Minnesota legislature was more generous with the state forestry board than ever before. A total of $275,500 for general forestry work was appropriated for the next two years, of which $125,000 a year is for fire protection. The last named sum was augmented by an additional allotment of $44,000 from the state board of relief. For the equipment of a flying field $45,000 was voted. This provision was to meet the offer of the federal government to furnish the service of twelve planes if the necessary hangars and flying fields were provided. While the primary purpose of this agreement is to supply aerial mail communication, the planes will be able also to render effective service in discovering forest fires.

In California, where there has been much favorable sentiment toward forestry for many years, the legislature voted a substantial increase in appropriation for the state board of forestry, for the biennial period beginning July 1. For the prevention and suppression of fire $75,000 was appropriated; for general administration, $27,000; for a study of watershed areas, $10,000, and to establish and maintain state forest nurseries, $35,000. The legislature also voted $300,000 for the purchase of redwood timber land for park purposes along the state highway in Mendocino and Humboldt counties, the area to be administered by the state board of forestry.

THE HARVARD SCHOOL OF PUBLIC HEALTH

Plans for the organization of a School of Public Health in Harvard University, with the aid of an initial gift of $1,785,000 by the Rockefeller Foundation, are announced by the university and the officers of the Foundation. The announcement says:

An excellent general course for the training of public health officers as well as special courses in preventive medicine, in tropical medicine and industrial hygiene have already been developed at Harvard. The work has been hampered, however, by lack of adequate funds and by uneven growth.

The new school will provide opportunities for research, will unify existing courses and will offer new or extended teaching facilities in public health administration, vital statistics, immunology, bacteriology, medical zoology, physiological hygiene and communicable diseases.

For the housing of the school the university hopes to secure an existing building of very suitable character immediately adjacent to the Medical School. Funds for the purchase and equipment of the building will be drawn from the gift of the Rockefeller Foundation.

The cost of maintenance and development of the school will be met from endowment funds in part set aside by the university and in part contributed by the Foundation. The Foundation's immediate appropriations to the project will aggregate $1,785,000. The arrangement also provides for further gifts, if the growth of the school seems to demand it, to any amount which shall not exceed $500,000.

Though the School of Public Health at Harvard will have its headquarters in a well-equipped building of its own and have its own separate faculty and administration, it will be developed in close relation with other divisions of the university, especially the Medical School.

The administration buildings of the two schools will, it is hoped, stand side by side on the same grounds; certain heads of departments will be members of both faculties; and a number of laboratories and lecture rooms will be used in common.

The school will be able to cooperate with a large number of laboratories, hospitals and public health agencies in Boston and thus afford its students unusual opportunities for first-hand investigation and practical field experience.

In addition, the school, through cooperative relations with a number of manufacturing and commercial corporations, will be able to offer the students practical experience in industrial hygiene.

There already exists a School of Public Health conducted jointly by Harvard University and the Massachusetts Institute of Technology. Professor M. J. Rosenau, of the Harvard Medical School, is the director of this school, and the other members of the administrative board are Professor G. C. Whipple, of the Harvard Engineering School, and Professor C. E. Turner, of the Massachusetts Institute of Technology.

SCIENTIFIC NOTES AND NEWS

THE British chemists who have been meeting at Montreal and Toronto will be welcomed at Niagara Falls by Governor Miller on Monday, September 5. The reception committee of chemists consists of Mr. S. R. Church, chairman of the American Section of the Society of Chemical Industry; Dr. Edgar F. Smith, president of the American Chemical Society; Dr. David Wesson, president of the American Institute of Chemical Engineers; Dr. Acheson Smith, president of the Electrochemical Society; and Drs. Charles F. Chandler, Ira Remsen, M. T. Bogert and William H. Nichols, past presidents of the Society of Chemical Industry. As has already been noted in SCIENCE, the opening meeting of the American Chemical Society in New York City will be at Columbia University at ten o'clock on the morning of September 7.

AT the recent second International Conference of Pure and Applied Chemistry held at Brussels, Professor Charles Moureau, of Paris, presided. The vice-president representing the United States was Dr. F. G. Cottrell, recently chief of the Bureau of Mines and chairman of the Division of Chemistry of the National Research Council.

GEORGE OTIS SMITH, director of the United States Geological Survey, has returned to Washington from London, where he went to serve as a member of the organization committee of the International Geological Congress, the next meeting of which is being arranged for August, 1922, at Brussels.

MR. C. J. WEST has left the position of director of the Information Department of Arthur D. Little, Inc., Cambridge, Mass., to become managing editor of the "Tables of Physical and Chemical Constants," which is being published by the National Research Council, in cooperation with the American Chemical Society.

MR. GEORGE A. OLSON has resigned as chemist of the Washington Agricultural Experiment Station and state chemist of the State of Washington, in order to accept the position as director of agricultural research and agricultural adviser for the Gypsum Industries Association, Chicago, Ill., which position was formerly held by Dr. William Crocker, who recently resigned to become the director of the Thompson Institute for Plant Research at Yonkers, N. Y.

FRANK C. MORRISON, assistant director of the agricultural experiment station of the University of Wisconsin, has been appointed a member of the committee on Animal Nutrition of the National Research Council.

B. D. PORRITT has been appointed director of research by the Research Association of British Rubber and Tyre Manufacturers.

FOLLOWING the recent transfer of the Port Erin Biological Station to Liverpool University (department of oceanography), Mr. Herbert C. Chadwick, who has been curator under

the Liverpool Marine Biology Committee for the last twenty-four years, has resigned, but remains on the staff of the institution as research assistant. Mr. J. Ronald Bruce has been appointed naturalist-in-charge.

We learn from *Nature* that at the annual general meeting of the Röntgen Society the following officers and council were elected: *President,* Professor J. W. Nicholson; *Vice-Presidents,* Dr. G. H. Rodman, Sir Ernest Rutherford, and Sir William Bragg; *Hon. Treasurer,* Mr. G. Pearce; *Hon. Secretaries,* Dr. E. A. Owen and Dr. J. R. Reynolds; *Hon. Editor,* Dr. G. W. C. Kaye; *Council,* C. Andrews, Dr. H. Black, A. E. Dean, Major Kenelm Edgcumbe, N. S. Finzi, Dr. F. L. Hopwood, Dr. F. H. Johnson, Dr. R. Morton, C. E. S. Phillips, Professor A. W. Porter, Professor A. O. Rankine, and Sir Archibald D. Reid.

The following physicians have been elected members of the Brazilian Congress: Professors C. Fraga and P. Mendes, from Bahia, and Professors A. Sodré, A. Austregesilo and Dr. M. de Medeiros from Rio de Janeiro.

Professor William H. Hobbs, of the University of Michigan, is now in Japan to make an investigation of the coral islands.

According to *Terrestrial Magnetism,* the New Zealand Government has made arrangements for the continuation of the magnetic and seismic work of the Samoa Observatory at Apia. Dr. Angenheister, in charge from 1914 to 1921, has returned to Göttingen, Germany. The New Zealand government did not have available funds for the observational work in atmospheric electricity and meteorology. Accordingly, Dr. H. M. W. Edmonds, of the Department of Terrestrial Magnetism of the Carnegie Institution, was stationed at Apia for the continuation, during the year, of the work and for the purpose of taking charge of the department's secular-variation work in the Pacific Ocean. He arrived at Apia the latter part of June. Mr. C. J. Westland, of New Zealand, succeeds Dr. Angenheister in the charge of the Observatory.

Professor Frank H. Bigelow retired from the directorship of the Observatorio Solar y Magnetico, Pilar, Argentina, on June 30, and will reside for the present in Southern France. He will prepare for publication a series of papers describing his researches on atmospheric physics.

Governor Baxter, of Maine, has received an undated letter from Captain Donald B. MacMillan, the Arctic explorer, now on an expedition to Baffin Land, in which he writes: "I have taken on the last provisions and fresh water and am now awaiting weather to clear before proceeding northward to Hopedale, the first Eskimo settlement. The *Bowdoin* is proving to be a wonderful sea boat. Had her going the other day with sea rail under and fore rigging cutting every wave."

The *Journal* of the American Medical Association states that as Ramón y Cajal will soon retire as professor of histology in the School of Medicine of Madrid, Dr. Van-Baubergen introduced a bill providing that Cajal should be appointed honorary dean of all Spanish medical schools, and that he should be granted an annual pension of 25,000 pesetas (about $3,200). The minister of public education, while endorsing its first paragraph, held that the pension could not be granted, as it would violate the budget law. Cajal tried to stop subsequent action in favor of the pension, publishing a letter in which he said, "The legend of the poverty-stricken and neglected researcher has no application in my case." Cajal asked in his letter that, rather than granting him a pension he does not need, they should increase the funds for the Cajal School. The government accepted the suggestion and increased by 50,000 pesetas (about $6,500) the annual appropriation for the school.

The *Journal of Industrial and Engineering Chemistry* states that the Fixed Nitrogen Research Laboratory, located at American University, Washington, has been transferred from the War Department to the Department of Agriculture. Dr. R. C. Tolman, director, will remain in charge, and the entire personnel of 110 to 120, including 50 of the best trained experts in the world on nitrogen, is transferred. Most of the work of the laboratory

has been done on the cyanamide process that is used in the Muscle Shoals plant, but the Haber and arc processes have also been studied. The laboratory will still consider nitrogen production from a military viewpoint, but it will do intensive work on problems of nitrogen supply for agricultural purposes. The laboratory and the Bureau of Plant Industry of the Department of Agriculture have in the past year made extensive field tests on various fertilizers produced at the Alabama plants, and it is planned to continue and enlarge these tests. Dr. R. O. E. Davis, in charge of the soil physical investigation of the Bureau of Soils, has been cooperating in these tests.

THE American Astronomical Society held its annual meeting at the Van Vleck Observatory, Middletown, Conn., from August 30 to September 1. The following observatories, colleges and institutions were represented: United States Naval Observatory, Lick Observatory, Mt. Wilson Observatory, Allegheny Observatory, Dominion Observatory (Canada), Dudley Observatory, Harvard, Yale, University of Illinois, Ohio State, Princeton, Massachusetts Institute of Technology, Swarthmore, Syracuse, Dartmouth, New York University, Brown, Amherst, Wesleyan, Vassar, Smith, Wellesley, Mount Holyoke, Eastman Kodak Company, Elgin Watch Company, Warner and Swasey Co., Alvan Clark Company and American Optical Company. The program for the meeting contained thirty-eight papers based upon observations with the spectroscope, seven papers dealt with stellar parallaxes or the distances of the stars and their distribution in space, and four papers were on the nebulæ.

THE British expedition which is aiming at the conquest of Mount Everest in the Himalayas, the world's highest peak, has completed its explorations to the north and west of the mountain without discovering a practical route to the summit, it is announced in a Reuter dispatch from Simla. Some hope is still entertained, however, that a route may be gained on the northeast flank of the great mountain, and when the monsoon abates another effort will be made. Meanwhile the headquarters of the expedition have been moved toward Kharta, upon which point the further effort will be based. The present expedition has surveyed about 10,000 square miles of territory on and adjacent to Mount Everest.

ACCORDING to the *Journal of Industrial and Engineering Chemistry,* the first conference of the complete Pharmacopeial Committee of Revision was held July 1 and 2, 1921, at Philadelphia, Pa. The first day was devoted to subcommittee conferences, and at the close of the day all subcommittees reported their current problems settled or decided as far as possible. The following day was devoted to a meeting of the General Committee. A committee was appointed to take up the recommendation of the Pharmacopeial Convention that a conference on international standards be called before the completion of the Tenth Revision of the U. S. P. An announcement was made of the authorization by the Board of Trustees of the use of the U. S. P. IX. text for translation into Chinese. It is expected that this will be accepted by Chinese government officials and become the Pharmacopeia of China, First Edition. It was also announced that individual work on pharmacopeial problems could by special permission be released for publication. A conference was held with the Prohibition Commissioner in regard to the proposed cooperation between the department and the Committee of Revision on all questions in which pharmacopeial alcoholic preparations are involved.

A NEW forest experiment station, the first in eastern states, has been established at Asheville, N. C., by the forest service of the United States Department of Agriculture. Steady depletion of the southern Appalachian timber supply has been responsible for the location of this station in the east; and the object of the work to be conducted will be to secure the information needed by foresters to determine the best methods of handling forest lands in the southern mountains.

THE provisional figures of births registered in England and Wales during the first quarter of 1921 show a decline of over 61,000 from

the record of the corresponding period of last year. Compared with the first quarter of 1914, however, the drop in numbers is under 8,000. Excluding the war years, the births are the fewest recorded in the first quarter of any year since 1872. The deaths registered also show a decline in numbers from the very low record of 1920, and are, indeed, the smallest in number registered in the first quarter of any year since 1868. The natural increase by excess of births over deaths was over 80,000, as compared with 133,000 in the March quarter of 1920 and 73,000 in 1914. The infant mortality was 101 per 1,000 births.

We learn from the *Journal* of the Washington Academy of Sciences that the purchase of additional land near the Connecticut Avenue entrance to the National Zoological Park, provided for in the Sundry Civil Bill for 1921, has been completed. The addition to the Park is about six acres, making the total area about 175 acres.

We learn from *Nature* that the governor-general of New Zealand, Lord Jellicoe, has formally opened the Cawthron Institute in Nelson, South Island. The institution was founded under the terms of the late Thomas Cawthron to provide a place for teaching and carrying out scientific research relating to the industries of Nelson and of the Dominion. Lord Jellicoe paid eloquent tribute to the great public generosity of the late Mr. Cawthron, and then spoke of the importance of scientific research. For an agricultural community to achieve success the agriculturists must cooperate with men of science. The work undertaken in the new institute will deal largely with problems of agriculture, fruit-growing, etc., and should therefore exert great influence on the prosperity of the whole of the Dominion. The Bishop of Nelson, who is chairman of the trustees, also addressed the gathering, and made particular mention of the library of scientific books belonging to the institute, which it was hoped, when completed, would be the best in Australasia. Professor Easterfield, director of the Cawthron Institute, gave a brief outline of the many lines of research now occupying the attention of the staff; soil surveys, experiments with fertilizers and cover-crops, fire-blight, the deterioration of trout, fruit pests, and the utilization of flax-waste were among the problems mentioned.

At a recent meeting of the Royal Geographical Society Dr. Knud Rasmussen explained the plans for his expedition to gather materials for an archeological and ethnographical survey. The expedition, which consists of Dr. Rasmussen, three other Danish scientific men and six Esquimaux, will leave the settlement of Holstemborg, in Greenland, for Hudson Bay at the end of August. The area to be explored is the central part of the archipelago, between Greenland and North America, comprising Ellesmereland, North Devon, North Somerset, Baffin Land, Borthia Felix, the Melville Peninsula and the Barren Grounds.

According to the daily press, a trading expedition to Siberia *via* the Kara Sea is on the point of leaving Europe. Two cargo boats from Liverpool, two from Hamburg, and one from Göteborg are to meet at the Russian port of Murmansk, where they will be rejoined by the ice-breaker *Alexandria* from Leith. The expedition is carrying about 11,000 tons cargo, most of which is to enter Siberia *via* the Yenesei River. The expedition is being organized by the All-Russian Cooperative Society, Limited, London.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. H. H. Wills some time since presented the University of Bristol with the sum of 200,000*l.* for the provision of a new physics laboratory, and a contract for the erection of a building has now been signed. It is estimated that the work will absorb the whole of the original gift, together with interest on the fund, amounting to 21,000*l.* The building will be named "The Henry Herbert Wills Physical Laboratory."

The board of curators of the state university of Missouri has taken a definite stand

in favor of establishing a four year course in medicine at the university. The board will prepare a bill for presentation at the next session of the legislature in 1923 to authorize and appropriate money for the establishment of a state hospital at Columbia to be operated in conjunction with the medical school.

DR. H. J. WEBBER has been appointed professor of citriculture in the University of California and director of the Citrus Experiment Station at Riverside, the position he held before he accepted an industrial position at Hartsville, South Carolina.

PROFESSOR A. V. MILLER, associate professor of drawing and descriptive geometry, has been apppointed assistant dean of the college of engineering of the University of Wisconsin, to take the place of Professor J. D. Phillips, who is now acting business manager during the year's leave of absence of H. J. Thorkelson.

DR. JOHN SUNDWALL, professor of hygiene and public health at the University of Minnesota, has been made director of hygiene and public health in the newly established department of physical education.

IN the Medical School, Boston, Dr. Fred Wilbur Thyng has been promoted to be professor of anatomy, and Dr. Jesse Leroy Conel has been appointed assistant professor.

PROFESSOR H. C. PLUMMER has been appointed professor of mathematics at the Ordnance College, Woolwich, England.

DISCUSSION AND CORRESPONDENCE

AN IMPORTANT BUT UNNAMED RADIOACTIVE QUANTITY

THE problems that are met in the quantitative study of radioactive materials and processes fall naturally into two classes. One class includes the strictly chemical problems; the other, the problems that are primarily concerned with radioactive phenomena, such as the rate of emission of energy and the rate of production of alpha particles. In problems belonging to the first class we are concerned with the total amount of material present; but in problems of the second class we are directly concerned with only the relatively small fraction (λN) of the atoms present that take part in the phenomenon studied; we are only incidentally interested in the atoms that have remained untransformed.

In such problems, comparable amounts of different radio-elements are such as correspond to the same value of λN. There should be a name by which to denote the amount of any radio-element, irrespective of family, that is thus comparable to a gram of radium. If, tentatively, we use the letter r to denote this quantity, then an r of any material may be defined as that amount of the material that will produce transformed atoms at the same rate as transformed atoms are produced by one gram of radium. This quantity plays in radioactivity a part that is analogous to that played by the gram-molecule in physical chemistry, and the adoption of some name for it will facilitate the recording, discussion, and presentation of observations and phenomena.

Thus arises the question whether the term "curie," which denotes an r of radium emanation, shall be redefined so as to cover the entire field embraced by our definition of the quantity r, or whether a new name shall be added to the nomenclature of the science. This question was submitted by the Bureau of Standards to a number of chemists and physicists; the majority of those who replied favored a redefinition of the "curie."

The advantages to be secured by adopting a name for the quantity here denoted by r are considered in greater detail in an article that will appear in an early issue of the *Journal* of the Washington Academy of Sciences.

N. ERNEST DORSEY

BUREAU OF STANDARDS,
WASHINGTON, D. C.,
July 30, 1921

THE VALUE OF TILTH IN AGRICULTURE

TO THE EDITOR OF SCIENCE: If the surface of the earth be broken up to a moderate depth, the growth of plants will be marvelously increased, as has been known from time immemorial.

A scientific explanation of this fact is sug-

gested by Mr. Jerome Alexander in SCIENCE, July 22, page 74, to the effect that the evaporating surface is increased by the comminution of the soil, with the resulting increase of evaporation of the soil water. This in turn results in a greater upward flow of the soil water from below, bringing with it a greater store of plant food than would normally be transported from the depths of the soil. This induced upward movement of the soil water is thought by the author of the note in question to account also for "the curious fact well known to farmers, that in dry weather, cultivation will to a considerable extent furnish moisture to the growing crops."

The value of cultivation (aside from the killing of weeds) is unquestionably the result of a number of diverse factors, the bare enumeration of which would transcend the limits of the space available in SCIENCE. So far, however, as the movements of the soil water are influenced by the comminution of the surface concerned, there are two chief results which prove of benefit to the growing crops.

By evaporation at the surface, the minerals held in solution are left behind at a locality inaccessible to the feeding roots, which can not long exist at the surface of the land. Cultivation of the surface moves this zone of concentration to the subsurface, and here the roots are able to take advantage of the greater concentrated solution of plant foods.

The well-known fact that tilth apparently increases the amount of moisture in the land is accounted for by the *exact reversal of the hypothesis suggested* by Mr. Alexander, the fact being that the comminution of the upper surface of the soil, instead of increasing the evaporation of the soil water, more or less perfectly *stops evaporation, and thus conserves the store of soil water.*

L. S. FRIERSON

GAYLE, LOUISIANA

BACTERIA IN THE AMERICAN PERMIAN

THE presence of bacteria in the closing period of the American Paleozoic has been suggested by the condition of the fractured reptilian spine, recalling an osteomyelitis, already noted.[1] At the time this first notice was written microscopic sections of the fossil spine had not been studied. Since then, I have received four transverse sections through the spine, showing in detail the nature of the sinuses which caused the tumefaction. Careful search through the sections has failed to reveal any sequestrum, such as is commonly found in modern chronic osteomyelitis, nor were bacteria found in the margins of the calcite filled sinuses. The presence of pathogenic bacteria in such a situation would be rather rare in a fossil state, since the nature of fossilization would prevent their preservation. It is doubtful too whether we could prove the pathogenicity of such bacteria save by their location.

Bacteria of the *Micrococcus* type, so common in the fossil vertebrate material studied by Renault from the Autun of France, are however abundantly preserved in the distorted osseous lacunæ. They are similar in all respects to those occurring in the fossil bone of fishes previously described[2] from the Devonian of America and Scotland. The bacteria, often seen isolated in the terminal bulb of the canaliculus-like burrows, which radiate out from the body of the lacuna, are no doubt those of decay and had nothing to do with the infection producing the osteomyelitis. There seems no doubt that bacteria of this type may be found in any fossil vertebrate material of the type which has been embedded in moist ground long enough to undergo a slight amount of decay, prior to fossilization. The only reason they have been seen so seldom in fossil vertebrate material is simply because no one has looked for them. They are there beyond any question.

The bodies which have been interpreted as bacteria, when seen isolated at a magnification of 1240 diameters, measuring from 1 to 2.5 microns, appear as semicrystalline, rounded, brownish bodies resembling minute specks of amber. The question as to whether they

[1] SCIENCE, N. S., Vol. LIII., No. 1371, p. 333, Apr. 8, 1921.

[2] SCIENCE, N. S., Vol. LI., No. 1305, p. 14, 1920.

are really bacteria has been satisfactorily discussed by the researches of Bernard Renault who has placed the subject of bacteriology of fossil vertebrate remains on a safe footing. Those seen in the present sections often group themselves in pairs recalling the modern *Diplococci.* I have never seen chains of these forms in vertebrate material.

The other question as to how such minute bits of protoplasm are capable of preservation over many millions of years is one of those unsolved puzzles of paleontology which we may place with that of the fossilization of the ganoid fish brains from Kansas.

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Chicago

QUOTATIONS

SCIENTIFIC PAPERS

Although the scientific societies made a valiant effort to preserve continuity through the war, the session now closed is the first that has been nearly normal for several years. Most of the younger men were engaged on work that does not qualify for membership of learned societies, and the scientific investigations of the others, young or old, were often advisedly kept secret. Now that science has resumed its old range and almost its old output the precise utility of the weekly and fortnightly meetings of the societies, under discussion before the war, is again being considered. Clearly they have a social value, increased by the almost universal change from the evening to the late afternoon, and by the more abundant presence of ladies, as members or as guests. But what of their specific function as an aid to the advancement of knowledge? It is to be confessed that for the most part this seems slight. Distinguished investigators are not always clear expositors by word of mouth. In many cases the programme is so long that many items, and these often the more interesting, have to be "taken as read." The actual communications made are often such that it is to be doubted if more than one out of ten of the audience has the slightest idea what it is all about. Sir James Dewar, speaking at the closing meeting of the Royal Institution, possibly partly in jest, ventured the opinion that it was good for people to listen to the most recent results of science, even if they failed to understand them. This is an opinion in which we can not concur, holding, on the contrary, that if there is a state worse than ignorance it is that of the vain worshippers of scientific shibboleths. If the purpose of a meeting is to convey instruction, the exposition should be as simple and clear as that to which Sir James Dewar himself has accustomed his audiences at Albemarle-street.

But the original purpose of the meetings of the scientific societies was to discuss new results rather than to educate. In earlier days, when the range of knowledge was narrower, almost any man of science was capable of emitting a useful impromptu opinion on almost any branch of science. An approach to such a communion between lecturer and audience may still be possible in some of the smaller and more highly specialized societies. In other bodies a useful attempt is sometimes made to reach it, by grouping the papers for a meeting, or by setting a topic for discussion. But even such arrangements frequently fail of their object, because those with most right to be heard are least anxious to criticize or to approve what they have heard for the first time, whilst those who have least claim to serious attention are most ready to hazard opinions. It would be interesting, were some society to experiment with a method frequently suggested, but, so far as we know, not yet actually adopted. It is the custom for the communications made at a meeting to be printed and published subsequently, after due examination by a referee. It is worth noting that strict precautions are taken to prevent substantial alteration or correction of a manuscript, even if the discussion had shown that these would be an advantage. There is threfore no gain by the delay, and much detriment to the value and interest of the meeting. If, on the other hand a paper were published in full, and distributed in the usual way at a due interval before the meeting at

which the author was to present it, experts and those with varying degrees of knowledge could master the main points of the thesis. They would thus be prepared to join in, or to listen to, a debate which would certainly be a real contribution to the progress of knowledge.—The London *Times*.

SPECIAL ARTICLES

ON THE LAW OF SURFACE AREA IN ENERGY METABOLISM [1]

THE generalization that heat production in animals is proportional to the surface of the animal body rather than the weight of the body was first hinted at by French writers before the middle of the last century. It was formulated rather definitely by Bergmann in 1848 and was first placed on a definite footing of fact almost simultaneously by Rubner in Germany and by Richet in France in 1885. This so-called law of surface area has been quite generally accepted and has contributed much to the understanding of metabolism which we now have.

Recently this law has been submitted to severe criticism by F. G. Benedict and his colleagues[2] and the conclusion has been reached that surface area is little or no better as a measure of metabolism than is body weight. The purpose of the present communication is to direct attention to some natural limitations of the law of surface area which seem to have been overlooked by these critics. Harris and Benedict have rendered a service to the science of metabolism and nutrition by calling attention to the fact that since surface is usually expressed as a quantity in which two thirds power of the weight enters as a factor it must of necessity be less variable than the weight. As a matter of fact the mathematical relationship does not stop here; for in many instances the constant employed in the formula, for example, of Meeh or of Lissauer, by which the two thirds power of the weight is multiplied, equalizes the proportions between surfaces and weights. A few illustrations will make this clear. Suppose, for example, we have two infants weighing 7 and 8 kilograms respectively. Expressing their weights in grams and their surfaces in sq. cm. by the Meeh and Lissauer formulæ, we have the proportions shown in the first line of the following table. The ratio of weights is .88 : 1 and of surfaces .91 : 1. Now it is obvious that if the metabolism of these two children is proportional to their weights it must of necessity also be nearly proportional to surface. With two youths weighing 40 and 41 kilos the surfaces bear to each other exactly the same ratio as the weights, whether the Meeh or Lissauer formula be employed. Both, therefore, will be equally good measures of metabolism for the two individuals. The "discovery" that surface is no better as a measure of metabolism, than weight *as between individuals of nearly the same weight* could, therefore, have been made with paper and pencil.

TABLE I.

Relation of Body Weights and Surfaces to Each Other

Weight Gm.	Ratio	Meeh-Rubner $11.9\sqrt[3]{(w)^2}$		Lissauer $10.3\sqrt[3]{(w)^2}$	
		Surface sq. cm.	Ratio	Surface sq. cm.	Ratio
7,000		4,354		3,769	
8,000	0.88	4,760	0.91	4,120	0.91
20 kgm...		0.8768 sq. m.		0.7589 sq. m.	
21 kgm...	0.95	0.9058	0.97	0.7840	0.97
40 kgm...		1.3920 sq. m.		1.205	
41 kgm...	0.98	1.4150	0.98 +	1.225	0.98 +
4 kgm...		0.299		0.259	
40 kgm...	0.10	1.3920	0.210	1.205	0.21
3.5 kgm...		0.274		0.237	
70 kgm...	0.05	2.021	0.135	1.750	0.136

[1] Abridged from an address delivered before the Yorkville Medical Society, New York City, March 21, 1921.

[2] Harris, J. A., and Benedict, F. G., "A Biometric Study of Basal Metabolism in Man," Carnegie Inst. of Washington, Publ. No. 279, Washington, 1919; Benedict, F. G., and Talbot, F. B., "Metabolism and Growth from Birth to Puberty," Carnegie Inst. of Washington, Publ. No. 302, Washington, 1921.

Contrast with this the relationship between individuals weighing 4 and 40 kilograms, or still better, an infant weighing 3½ kilograms and a man weighing 70 kilograms. The weights are to each other as .05 to 1, and the surfaces as .135 to 1. In other words, the weight of the larger individual is twenty times that of the smaller, while the surface is a little over seven times that of the smaller. In this case the weight and surface can not possibly be of equal value as measures of the metabolism. One is nearly three times as good (or as bad) as the other. As a matter of fact it is now well known that surface is about two and one half times as good a measure as weight between two such individuals.

In the judgment of the writer it is incorrect to suppose that physiologists have believed the metabolism to be absolutely proportional to surface, regardless of circumstances. Rubner for the German literature and Richet for the French are responsible for the first demonstrations of the applicability of the law. Rubner worked with dogs of adult stature but widely different size, estimating their metabolism by the indirect method. Richet worked first with rabbits ranging from 2,000 to 3,500 grams in weight but he determined only the heat of radiation and conduction, neglecting, as nearly all subsequent French observers have done, the heat given off by evaporation. Naturally his quantities would be more nearly proportional to surface than the total. However, in the estimation of surfaces he says,

> If one supposes that animals of different size are like spheres of different volumes, then the respective volumes are related among themselves as the cubes of their radii; while the respective surfaces are related among themselves as the squares of their radii. These considerations apply to living animals, and, since their form is so irregular compared with that of a perfect sphere, one can only apply the geometrical facts to them approximately.[2]

Further in summing up the factors which determine heat production Richet notes that one of these is "the nature of the integument." In two important respects, therefore, Richet made saving clauses regarding the application of the law of surface, one concerning the measurement of surface and the other concerning the nature of the skin, meaning, of course, its conducting properties. Rubner in the beginning considered that he had demonstrated the law only for adult animals and later in applying it to children made this very emphatic reservation:

> The law of surface area holds under all physiological conditions of life, but for its proof it is a reasonable presumption that only organisms of similar physiological capacities, as regards nutrition, climatic influences, temperament,[3] and functional power, should be compared.[4]

Other students of metabolism have made similar reservations. Thus Schlossman says,

> The presumption is on the one hand that the environment is relatively normal, on the other that the child has a relatively normal surface, that is, a functioning and good conducting skin with the normal amount of subcutaneous fat.[5]

Otherwise, he thinks, the law could not be expected to apply.

One other point of some importance may be mentioned in this connection. There has been much discussion regarding the formula which should be used to express the body surface of infants. Rubner and Huebner modified the old formula of Meeh changing the constant from 12.3 to 11.9. Later Lissauer, from the measurements of a group of infants most of whom were distinctly undernourished, found the constant 10.3 to be more exact. Then came the formula of Howland and Dana of the $y = mx + b$ form, and still more recently the height-weight formula and the linear formula of DuBois, the latter similar to one previously devised by Roussy and first applied to infants

[2] Richet, Ch., "Recherches de Calorimetrie," *Arch. de Physiol. norm. et path.*, 1885, 3d ser., VI., 237.

[3] Misquoted as "temperature" by Harris and Benedict, loc. cit., p. 196.

[4] Rubner, M., "Ernährungsvorgänge beim Wachstum des Kindes," *Arch. f. Hyg.*, 1908, LXVI., 89.

[5] Schlossmann, A., "Atrophie und respiratorischer Stoffwechsel," *Zeitschr. f. Kinderheilk.*, Orig., 1912–13, V., 227.

by Variot and Lavialle. Benedict and Talbot have recently shown that the linear formula of DuBois gives results very nearly the same as the formula of Lissauer with a somewhat variable constant. Which of these formulæ is most nearly correct for body surface can only be determined by a statistical study of a large number of cases. However, if one of them is clearly superior to the others as a measure of heat production it should appear in the coefficients of correlation between heat production and surface as measured by the several formulæ. Harris and Benedict include in their statistical studies the basal metabolism of a series of 94 newborn infants, previously published by Benedict and Talbot. They did not, however, carry the analyses so far as to determine which formula gives the closer correlation with heat production. I have taken the trouble to work out the coefficients of variability and of correlation for the Boston series of 94 newborns using four different formulæ. They are given below.

TABLE II

Coefficients for the Minimal Metabolism of Newborn Infants (According to the data of Benedict and Talbot)

Coefficients of Variability	Coefficients of Correlation
$Vh = 15.37 \pm 0.79$	
$Vw = 14.68 \pm 0.72$	$\mathrm{P}hw = 0.7530 \pm 0.0205$
$Vs_M = 9.92 \pm 0.48$	$\mathrm{P}hs_M = 0.7672 \pm 0.0202$
$Vs_L = 10.08 \pm 0.49$	$\mathrm{P}hs_L = 0.7762 \pm 0.0195$
$Vs_H = 10.25 \pm 0.50$	$\mathrm{P}hs_H = 0.7677 \pm 0.0202$
$Vs_D = 8.84 \pm 0.43$	$\mathrm{P}hs_D = 0.7682 \pm 0.0202$

V_h = Coefficient of variability of heat production, V_w of weight; etc. s_M = Surface by Meeh-Rubner formula ($s = 11.9 \sqrt[3]{(w)^2}$); s_L = Surface by Lissauer's formula, ($s = 10.3 \sqrt[3]{(w)^2}$); S_H = Surface by Howland and Dana formula ($y = mx + b$, where x is body weight, m represents a constant 0.483 and b represents 730 sq. cm.); S_D = Surface by weight-height formula of DuBois and DuBois ($s = \mathrm{wt.}^{0.425} \times \mathrm{ht.}^{0.725} \times 71.84$).

There are two surprises in this table: one, that heat production as determined by Benedict and Talbot is more variable than either body weight or body surface, no matter by which formula it is measured; and the other, that it makes very little difference which formula is used for body surface so far as correlation with heat production is concerned. The formula of Howland and Dana gives the most variable body surface; the height-weight formula of DuBois, which has never been confirmed for infants, gives the least variable. But the formula of Lissauer gives a body surface which parallels the metabolism *slightly* better than the others, the difference, however, being altogether negligible. Taking the entire group of newborns in this series we may conclude that the sleeping metabolism, which is practically the whole of metabolism in the newborn, is as well measured by one formula as another; also that surface by any formula is but slightly better than body weight as a measure.

We must distinguish clearly the arguments against the law of surface as of two classes: (1) on the basis of fact and (2) on the basis of explanation. The arguments against the law, so far as they rest upon facts, seem, as we have just seen, to have been misconceived. It never was supposed by its chief proponents that the law would apply to all physiological and pathological conditions but only to similar physiological (normal) conditions. Also, a very superficial understanding of the necessary mathematical relations shows that the law has natural limitations which must be recognized if one is to avoid compromising it with impossible conditions.

There is no doubt that Rubner, following Bergmann, first conceived of the law as casually related to Newton's law of cooling. This dependence as commonly accepted may be phrased in this way. Solid bodies when warmed lose heat in proportion to the difference between the temperature of the body and the temperature of the surrounding medium. Since this heat must all pass through the surface it follows, other things equal, that they will lose heat for any particular gradient of temperature in proportion to surface. As applied to the animal body it is observed that the body temperature is *nearly* constant. Hence, if heat is lost in proportion to surface, it must also be produced in proportion to surface. This implies a causal relationship between surface loss and interior

production of heat. It is this causal relationship to which Benedict and Talbot in their latest publication make objection. They say,

As the result of the critique of the body surface law presented by Harris and Benedict, we believe that the accurate measurements of body surface made possible by DuBois may legitimately be used in a manner heretofore never practicable in metabolism experiments, provided that they are considered as physical measurements and with no erroneous conception as to the existence of a causal relationship between surface area and heat elimination.[6]

Nevertheless they compute many of their measurements by the Lissauer formula and find that many others as given by the DuBois linear measurements agree with the Lissauer formula provided a "constant" varying from 10.0 for infants up to 6 kgm. to 11.5 for youths between 25 and 40 kgm. is used. How the use of a physical measurement instead of a formula which agrees with the physical measurement improves matters it is difficult to see. The elaborate biometric analysis of Harris and Benedict has proved nothing more regarding the causal relationship than is proved by the simple mathematical analysis shown in Table I. Whatever the physical measurement of surface, if it can be expressed even approximately by a formula such as Lissauer's, it will follow that the ratio of body weights for certain ranges will be the same as the ratio of body surfaces *provided the weights are not far apart,* and for subjects of a continuous series in which weights differ by small increments it will follow that surface will be only a little, if any, better as a measure of metabolism than weight.

The question of causal relationship stands just where it always has stood. If the possession of a large surface in proportion to weight, as in a mouse, is accompanied by a vastly higher heat production per unit of weight as compared with a horse, but the heat production is found to be proportional to the surfaces of two such animals with approximately the same body temperature, it seems to follow that surface loss of heat is at least a more probable *cause* of heat production than body mass. The same is true as between a baby and a man. How else are such facts to be explained?

A word as to the teleological aspect of the case. Since heat production of animals seems to be proportional to surface area, it would seem to follow that heat is produced *in order to* replace that which is lost, or *to maintain* body temperature. This view some say, denotes an all too naïve conception of nature. Blood does not coagulate in order to prevent hemorrhage, but because certain chemical agents are present and certain properties. The fact that it does stop hemorrhage is quite incidental. It may have selective value, so that a species whose blood did not clot would have the worst of it in the struggle for existence, but it will never do to say that this chemical-physiological function originated for the purpose of preventing hemorrhage; for that would imply a mind at work in anticipation of the result. So also with heat production. These critics, of whom Kassowitz has been chief, prefer to account for heat production in a perfectly causal manner.

Small animals maintain a higher rate of oxidation, it is true, than large ones, but this is not because they lose heat more rapidly in consequence of greater (relative) surface, but because their alternating movements (later phases caused reflexly by earlier phases) follow one another more rapidly on account of shorter nerve paths.[7]

Kassowitz indeed finds that the higher rate of oxidation in small, warm-blooded animals has even for them "dysteleological consequences; for because of the more extensive muscular contractions more food and reserve substances are placed in requisition and by this means the deposit of reserve fat in the whole body, and especially in the subcutaneous tissues, is made more difficult, so that the protection against cooling—which a thick layer of fat prevents—fails in part amongst the very animals which need it most."[8] Even

6 Benedict and Talbot, *loc. cit.*, p. 159.

7 Kassowitz, M., "Allgemeine Biologie," 1904, Chap. XXV., par. 40.

8 Kassowitz, M., "Der grossere Stoffverbrauch der Kinder," *Zeitschr. f. Kinderheilk.*, 1913, VI., 247.

Kassowitz is obliged to admit, however, that "in warm-blooded animals which are in a position to maintain their own body temperature under the most diverse conditions, one can claim the appearance of some justification that their living parts produce heat in order to protect the body against loss by radiation, etc."[9]

Whether this is a real justification or only the appearance of one will not trouble the practical physiologist so long as the generalization that human beings of different size produce heat in proportion to surface rather than weight, and therefore, require food energy in this proportion, helps him to understand his feeding problems; and there is no doubt that the law of surface area has been immensely useful in this connection. It explains the much higher basal metabolism per unit of weight of the small individual in comparison with the large better than the so-called causal explanation cited by Kassowitz. It explains also much better the need for conservation of heat in the infant, and the role which subcutaneous fat plays in this connection.

John R. Murlin

University of Rochester

[9] Kassowitz, M., *ibid.*, p. 240.

ON THE SIGNIFICNACE OF AN EXPERIMENTAL DIFFERENCE, WITH A PROBABILITY TABLE FOR LARGE DEVIATIONS

The results of experiments from which scientific conclusions are drawn always constitute a sample, limited in number, of a potentially unlimited universe. The argument is always from the limited number to the infinite number, and assumes that the sample is representative of the universe. This is a priori not necessarily true, which is proven in the fact that two sets of measurements of supposedly the same quantity never agree in any absolute sense, that they may disagree widely, and that they therefore have to be qualified by a measure of their precision, which is derived from the magnitude of the mutual disagreement of the individual measurements of the same set.

This fact becomes of trying significance in many biological measurements. We may make two sets of measurements, A and B, under conditions alike except for one experimentally varied factor, and find that although their means show an apparently definite difference, many of the measurements A lie beyond the mean of B, and vice versa. It may be that a plot of the aggregate of the two distributions shows little or no bimodality corresponding to the difference in the respective conditions of A and B.

The usual mode of procedure in such a case is, first, to compute the measure of precision of the difference of the two means, according to the formula:

$$\sigma_\Delta = \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}},$$

where Δ is the difference between the arithmetic means $(M_1 - M_2)$, σ_Δ its standard deviation, σ_1 and σ_2 are the standard deviations[1] of the two distributions A and B, respectively, and N_1 and N_2 are the respective numbers of measurements.

Then the probability, P, of a deviation lying within the limits $\pm\Delta$, in a normal distribution of standard deviation σ_Δ, is found from the table.[2] The complement of this, $1 - P$, is the probability of such a deviation lying outside the limits $\pm\Delta$.

The accompanying probability table was computed by the writer for deviations higher than those included within the range of most such tables extant, with a view to giving values of P much nearer to unity than usual. An approximate method of computation was used. While the computation of values of

$$\int_0^x e^{-x^2} dx$$

[1] This assumes that

$$\sigma_1 = \sqrt{\frac{\Sigma\delta_1^2}{N_1 - 1}}.$$

Where N_1 is large the error due to the use of N_1 instead of $(N_1 - 1)$ tends to become negligible.

[2] Such as Table IV., pp. 119–125, Davenport, "Statistical Methods," third edition, New York; or Table 24 or Table 25, Smithsonian Physical Tables, Seventh Edition, Washington, 1920.

is laborious, excessively so where, as in the present case, many decimal places are required, it is possible to make a closely approximate integration of small segments of the function:

$$ydx = e^{-x^2}dx$$

such as

$$\int_{-z}^{z} e^{-(a+z)^2}dz,$$

where a is any abscissa and z is small.

Expanding the exponent, this becomes:

$$\int_{-z}^{z} e^{-a^2} \cdot e^{-2az} \cdot e^{-z^2},$$

which by putting

$$e^{-z^2} = 1 - z^2,$$

becomes

$$e^{-a^2}\int_{-z}^{z}(1-z^2)e^{-2az}$$

$$= e^{-a^2}\left[e^{-2az}\left(\frac{z^2-1}{2a}+\frac{z}{2a^2}+\frac{1}{4a^3}\right) - e^{2az}\left(\frac{z^2-1}{2a}-\frac{z}{2a^2}+\frac{1}{4a^3}\right)\right].$$

Reducing and substituting for z the value 1/10 gives:

$$\int_{-1_0}^{1/10} e^{-(a+z)^2} = \frac{e^{-a^2}}{4a^3}\left[(e^{a/5}+e^{-a/5})a/5 + (e^{a/5}-e^{-a/5})(1.98a^2-1)\right].$$

Thus, by assigning values to a, progressing by 0.2, the areas of the segments of the integral for the abscissal intervals $a \pm 1/10$ could be closely approximated and summated, the values in the table being finally:

$$\log\left(2\int_{x}^{\infty}\frac{h}{\sqrt{\pi}}e^{-h^2x^2}dx\right):$$

or log $(1-P)$, according to the usual symbology. It was found that it was only necessary in the extreme value given ($hx = 7.0$) to carry the computation a few steps farther, in order that the sum of the subsequent segments to infinity should be a vanishing quantity with respect to the degree of precision decided upon. The table is not to be looked upon as more than supplementary to the tables in general use, and upon examination, it will appear that the error introduced by assuming that $e^{-z^2} = 1 - z^2$ is negligible since, for $z = 1/10$ this error at its maximum is only as $0.99 - 0.99005$ to 0.99, or 5 parts in 99,000 *with respect to* $1-P$, and on the whole, even less than this; and it is the values of $1-P$, smaller than those obtainable from the usual tables, in which we are here interested. The values of this table check with those in the usual tables, as far as the latter go, and also (in the extreme cases, especially where $hx = 5.0$, 5.5 and 6.0) with the values given in the original work of Burgess.[3]

EXPLANATION OF TABLE

Common logarithms of the values of the integral:

$$2\frac{h}{\sqrt{\pi}}\int_{x}^{\infty} e^{-h^2x^2}dx \; (=1-P)$$

for various values of hx.

$$hx = \frac{0.4769x}{E} = \frac{0.7071x}{\sigma},$$

where E is the probable error and σ the quadratic mean error.

Interpolations will be fairly accurate to the fourth place if proper account be taken of the second difference.

hx	log (1 — P)	hx	log (1 — P)
0.0	0.0000	3.5	3.8710–10
0.1	9.9482–10	3.6	3.5513
0.2	9.8906	3.7	3.2231
0.3	9.8270	3.8	2.8865
0.4	9.7571	3.9	2.5415
0.5	9.6808	4.0	2.1880
0.6	9.5978	4.1	1.8261
0.7	9.5081	4.2	1.4557
0.8	9.4115	4.3	1.0768
0.9	9.3077	4.4	0.6895
1.0	9.1967	4.5	0.2936–10
1.1	9.0784	4.6	9.8893–20
1.2	8.9527	4.7	9.4764
1.3	8.8195	4.8	9.0551
1.4	8.6787	4.9	8.6252
1.5	8.5301	5.0	8.1868
1.6	8.3739	5.1	7.7399

[3] Burgess, *Trans. Roy. Soc. Edinb.*, XXXIX., p. 257 ff. "On the Definite Integral $(2/\pi)\int_0^t e^{-t^2}dt$ with Extended Tables of Values."

1.7....8.2098	5.2....7.2844
1.8....8.0378	5.3....6.8204
1.9....7.8579	5.4....6.3479
2.0....7.6700	5.5....5.8668
2.1....7.4741	5.6....5.3771
2.2....7.2702	5.7....4.8789
2.3....7.0581	5.8....4.3721
2.4....6.8379	5.9....3.8567
2.5....6.6095	6.0....3.3328
2.6....6.3730	6.1....2.8003
2.7....6.1282	6.2....2.2593
2.8....5.8751	6.3....1.7096
2.9....5.6138	6.4....1.1514
3.0....5.3442	6.5....0.5846
3.1....5.0663	6.6....0.0092–20
3.2....4.7800	6.7....9.4252–30
3.3....4.4854	6.8....8.8326
3.4....4.1824	6.9....8.2314
3.5....3.8710–10	7.0....7.6216–30

PERCY W. COBB

LABORATORY OF PURE SCIENCE,
NELA RESEARCH LABORATORIES
May, 1921

POLARIZATION OF SOUND

THE term polarization, applied to a wave motion, is generally associated only with transverse waves, more especially with light-waves, as referring to a state in which certain qualities are different in certain directions at right angles to one another and to the direction of propagation. By its origin, however, the term may be used with the same justification for longitudinal waves exhibiting qualities that are different in different directions, irrespective of the nature of such qualities and the relation of the various directions to each other.

It is thus proper to speak of a polarization of sound when conditions prevail under which a quality like its pitch is of opposite character to opposite sides of a fixed plane or axis.

Such conditions may be brought about by putting the source, which for the sake of simplicity is supposed to produce a sustained sound of uniform pitch, through certain movements. It is well known that when such a source is in motion the pitch of the sound emitted into space will be a function both of the direction of the movement and its speed.

This is due to the relative displacement of the individual wave rings by the motion, and is readily observed by anyone standing close to a railroad track while a locomotive blowing its whistle is passing. At the instant of passage there is a sudden fall in the pitch of the blast, the fall being approximately proportional to the speed of the locomotive.

The pitch observed at any point may be expressed by the formula:

$$p = q\frac{v}{v-u},$$

p denoting the pitch observed, q the pitch produced, v the velocity of sound, and u the speed component of the movement in the direction of the observer, with due consideration of its sign.

If the source, instead of being moved at uniform speed in one direction, is made to perform a harmonic oscillatory movement at right angles to a plane P, and symmetrical to it, then the resulting sound will be of uniform pitch only at points located in this plane, assuming the extent of the movement to be small as compared with the distance to the point of observation. To either side of the plane the pitch will be undulating, the undulations reaching their maximum amplitude at points directly in line with the movement.

While the undulations will be of the same amplitude at any two points symmetrically located with respect to the plane, they will be opposite in phase and, therefore, of opposite character. Accordingly, if the source is made to emit sound while to one side of the plane only, *i.e.*, during alternate half oscillations, then, by the above formula, the resulting sounds will be of descending pitch to that side of the plane, while to the opposite side of it the same sounds will be of ascending pitch.

The sound may thus be said to have been polarized with respect to the plane P.

If the oscillatory movement of the source is substituted by a rotation at uniform speed about an axis A, results of a similar nature are obtained. In this instance, however, the resulting sound will be of uniform pitch only

at points directly in line with the axis, while aside of it the pitch will be undulating. The undulations will reach their maximum amplitude at points located in the plane of rotation, being of opposite character at any two points symmetrically located with respect to the axis.

In the terminology of optics, the sound may be said, in the latter case, to have been circularly polarized with respect to the axis A.

Polarized sound-waves may be of value in acoustic research, for investigations involving the direction of sound. They are also applicable to practical purposes, like fog signalling. The signals may be polarized in such a way as to enable a pilot to determine with ease and certainty, *and by the unaided ear*, the direction from which they are coming. A device for this purpose has already been constructed by the writer and has successfully stood the test, it being possible to locate the source within a "point" of the compass.

ANDERS BULL

CHICAGO, ILL.,
June 27, 1921

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF CHEMISTRY OF MEDICINAL PRODUCTS

Charles E. Caspari, *chairman.*
Edgar B. Carter, *secretary.*

N-derivatives of arsphenamine. I. Introduction of fatty acids: GEORGE W. RAIZISS and JOSEPH L. GAVRON. *II. Aldehyde addition products:* GEORGE W. RAIZISS and ABRAHAM C. BLATT. The authors introduced various atomic groupings in arsphenamine and studied the biological properties of the resulting compounds. They observed that the amino groups have a controlling influence upon the toxicity of the drug. Five derivatives of arsphenamine each containing a fatty acid substituent in both amino groups have been prepared. On the whole they are less toxic than the parent substance. Addition products of arsphenamine and various aldehydes, in which two molecules of the aldehyde are combined with one of arsphenamine, have also been prepared. Some of these have characteristic colors and may prove to serve as a means of identification. The biological study of these compounds is still in progress. One has been found less toxic than arsphenamine and also exhibits marked trypanocidal properties.

Some recent observations on protoplasmic stimulus: G. H. A. CLOWES. It has long been known that the sperm of sea urchins and other marine forms may be stimulated to excessive activity and their fertilization capacity promoted by treatment with extracts and secretions of eggs of the same species. This substance has now been proved to be a volatile, readily oxidized, non-specific, organo substance, resembling the lower alcohols or mercaptans. Similar sperm stimulating and fertilization promoting results may be obtained by utilizing a large variety of organo substances at dilutions of one in a hundred million or more.

Significance of residue determination as a test for the purity in drugs and chemicals: H. V. FARR. Salts of potassium and sodium are apparently more volatile in the presence of vapors of other metals, making their determination by ignition difficult in such compounds as mercury salts. The results seems to indicate widely different interpretations of the ignition test by different chemists. A much more accurate definition of the U. S. P. requirement is essential.

A new use for edible oils in surgery: CHARLES BASKERVILLE. Numerous efforts have been made to introduce gaseous anesthetics, as ether vapor, into the lower bowel until Dr. J. T. Gwathmey, of New York, conceived the idea of utilizing the solubility of ether in oil and administering the mixture as an enema. Fundamental factors were established by the investigations of the author before the proposal was tried with human beings. He determined the rates of evaporation of ether from various oils, mainly vegetable, although Russian mineral oil was also used. It was conclusively proven that ether evaporates from its solution in or of various oils suitable for internal use at a definite rate at the temperature of the human body. Nearly 30,000 operations, every one successful from the patient's point of view, have been performed by using this method. Not a single untoward circumstance has been reported. Vomiting, post-anesthesia nausea and many other uncomfortable accompaniments have been reduced to a minimum. Gwathmey also introduced the oral administration of the oil-ether mixture to produce analgesia during the dressing of wounds. Some surgeons have utilized the method in civilian practise in dressings after operations.

Further study of saligenin and allied compounds:

Arthur D. Hirschfelder. Saligenin in two to four per cent. solution is a practical local anesthetic not only for minor but also for major surgical operations such as thyroidectomies and laparotomies, and for caudal anesthesia; in 4 to 8 per cent. solution it is particularly useful in anesthesia of the male and female urethra for cystoscopy. Quigley and Hirschfelder have shown in a series of phenyl carbinols that substitution for one of the inactive hydrogens of the carbinols lessens the anesthetic action and substitution of both causes it to be lost. Ethyl, propyl, *n*-butyl, iso amyl and benzyl ethers of saligenin were prepared from potassium saligenate and the corresponding halide. They all numb the tongue like cocaine, the butyl ether most, but all also produce a stinging sensation as well. Emulsions made with acacia lower the blood pressure on intravenous in rabbits, the benzyl ether producing the most lasting effects. The mono acetic, di benzoic and mono benzoic esters of saligenin have been prepared, as well as the acetate and salicylate of bromsaligenin.

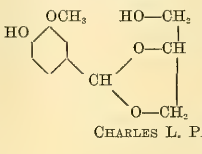
Molecular magnitude and physiological action: Oliver Kamm. Molecular volume data were utilized to predict the relative acute toxicities of monohydroxy alcohols belonging to several different homologous series. Benzyl alcohol and its homologues were found to agree with predicted values.

Preparation and hydrolysis of benzyl esters: E. H. Volwiler. Benzyl benzoate as an antispasmodic has come into increasingly general use since it was first suggested by Macht. With the purpose of finding the benzyl esters best adapted as antispasmodics, a number of other benzyl esters, both new and old, were prepared and their hydrolysis rates determined. The rates of hydrolysis of these benzyl esters increase in the following order: salicylate, benzoate, stearate, cinnamate, acetate, succinate, and fumarate. Benzyl acetylsalicylate, a new compound melting at 26°, was prepared; its rate of hydrolysis is very rapid, due to the presence of the acetyl group. It is therapeutically the most active of all the benzyl esters investigated.

Arsphenamine: Some factors which influence its colloidal properties: A. E. Sherndal. When the pentavalent aryl arsenic acids are reduced to the trivalent arseno compounds, their well marked crystalloidal characteristics are suddenly replaced by decidedly colloidal tendencies. This may be caused by the formation of large complex molecular aggregates. Arsphenamine in dry form shows marked colloidal properties, which vary in degree with the method of preparation. Precipitation from ionized solutions tends to increase these colloidal tendencies, while anhydrous non-electrolytes tend to reduce them to a minimum, as shown by experiment. These variable colloidal characteristics are paralleled by differences in the disperse state of acid and alkaline arsphenamine solutions, and may account for hitherto unexplained toxic and biologic phenomena exhibited by such solutions.

Laboratory tests vs. clinical results: Robert P. Fischelis. A discussion of the need for clinical evidence of the value of medicinal products and how such evidence may be obtained. The author included a discussion of the necessity for drawing proper conclusions from laboratory tests, as compared with clinical results.

Vanillin glyceride: Francis D. Dodge. A crystalline deposit which had formed after a time in a flavoring mixture composed essentially of vanillin, glycerin and alcohol was found to be a compound of vanillin and glycerin, apparently analogous to the benzol-glyceride described by Fischer. The compound is obtained more readily with acid catalysts (hydrochloric or sulfuric acids) and when purified melts at 159°. It is very slightly soluble in water or ether, more readily in alcohol, and may be recrystallized from hot alcohol. It is soluble in aqueous potassium hydroxide, and is reprecipitated by acids. The compound is hydrolyzed by hot water, yielding vanillin and glycerin in equivalent amounts. It is also very quickly hydrolyzed in acid solutions, so that the preparation requires much care. For purification, the crude crystals are dissolved in the calculated amount of $0.5N$ KOH, and reprecipitated by somewhat less than the theoretical amount of acid. The compound thus obtained forms thin plates, which are stable in dry air. Under the microscope, the crystals show, in convergent polarized light, an orthorhombic interference figure, and are thus easily distinguished from the monoclinic needles of vanillin. The formula is probably:



Charles L. Parsons,
Secretary

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MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE NATURE OF MAN[1]

A few years ago, as you may remember, Élie Metchnikoff published a book entitled "The Nature of Man: Studies in Optimistic Philosophy." If you have read that interesting work, you know that it is chiefly concerned with the great problem of death—with the problem, that is, of adjusting human emotions and human understanding satisfactorily to the common doom of living creatures. In Metchnikoff's view that problem has been mainly responsible for the existence of religions and philosophies. In his belief religions and philosophies have not been able to deal with the problem satisfactorily; but their failure, says he, is no reason for despair; for it is his conviction—and here we see why he deemed his study to be one in optimistic philosophy—that the problem can be satisfactorily solved by science and in particular by the science of biology, for the process of dying is one of the processes of life. And so his book aims at being an important contribution to what may be called the science or the philosophy of death.

I hope that this address upon "The Nature of Man" may appear to you, as it appears to me, to be, likewise, a study, or the result of a study, in optimistic philosophy. It is not of death, however, that I intend to speak, but of life. I desire to look towards the possibility—to contemplate the possibility—of a valid philosophy, or a science, of human life.

The core of my message is a certain concept—a concept regarding the essential nature of man. The concept is, I believe, both new and important—strictly new, if I be not mistaken, and tremendously important. This judgment I may express with propriety because the idea

[1] Address at the annual meeting of the Phi Beta Kappa Society, Columbia University, May 31, 1921.

in question did not originate with me. I should be proud if it had. I encountered it a little less than a year ago in an unpublished manuscript which by good fortune it became my privilege to examine. And so the conception is mine only by acquaintance, by meditation upon it, by a steadily growing sense of its significance, and by adoption—adoption of it, I mean, as an inspiring idea of great beauty and as a fruitful working hypothesis. The manuscript, I am happy to report, is now being published (by E. P. Dutton and Company) in the form of a book entitled "The Manhood of Humanity: The Science and Art of Human Engineering," and will appear very soon. The author of it is a Polish nobleman, Count Alfred Korzybski, a native citizen of Warsaw, by temperament a poet and philanthropist, by training and experience a mechanical engineer and soldier, twice wounded in the war; about six years ago transferred as a military expert to North America where, both in the United States and in Canada, he worked hard in the cause of freedom.

The book is, in my opinion, a momentous contribution to the best thought of these troubled years—momentous in what it contains, even more so in what it suggests, and most of all, I dare say, in the excellent things it will eventually help men and women to think and say and do. I am not going to review it on this occasion. Having examined the work carefully and reflected much upon it, I am convinced that its significance can be grasped and felt, not indeed by reading or listening to any review of it, but only by reading the work itself, re-reading it and pondering it. What I purpose to do is at once something less and something more—I hope a good deal more—than the submission of a review. The work deals with a wide variety of ideas; these do not constitute a mere collection; they constitute a system—the ideas are connected—logically connected—spiritually interlocked in many ways. It happens that among the ideas of the system there is one which dominates all the rest, binding them together, giving them their proper order, their life, their light and their significance—its place in the system is like that of the sun in the solar system. That central idea is Korzybski's concept of Man—a concept of what is characteristic of humankind; it is, in other words, a thesis purporting to state what that is in virtue of which we human beings are human. I desire in the first place to present that thesis, or conception, as clearly as I can, for your consideration both now and in the future; it will be my further aim to indicate, in so far as time allows, some of the bearings it seems to me to have upon the cardinal interests of mankind.

The task is not easy to perform well in the time at our disposal. In trying to perform it, I am going to invite you to join me in an attempt to do a little fundamental thinking. I extend the invitation confidently for the reason that the mood of such thinking is the only mood that befits the times. The World War has indeed constrained us to think about realities as we never thought before, and there is one thing of which we are all of us convinced—it is only by thinking of realities that we may hope to solve the pressing problems of the world. That is a great gain and is full of promise but it is only a beginning. In this presence it is unnecessary to argue that in dealing with realities it is of the highest importance to have just conceptions of them; I desire to emphasize the prime importance of concepts that correspond to facts; certainly in this presence it is unnecessary to argue that, in order to deal successfully with the great human problems of our time, it is not sufficient to have enthusiasm, sincerity and good-will; we know that, in addition to these excellent things, it is indispensable to acquire true conceptions of the realities involved. Now, of all the realities with which we humans have to deal, of all the realities involved in the present perplexities of the world, it is evident that the supreme reality is man. It follows that of all the questions we human beings can ask—of all the questions which in reflecting upon the ills of our time we *must* ask—the supreme question—the most fundamental question—is: What is man? What is a human being? What is the defining or

characteristic mark of humankind? In the scheme of nature, what is the place—the distinctive place—of the human class of life?

The sovereign importance of that question seems perfectly evident and is thus evident *a priori*. Have we propounded it to ourselves? In the published thought of recent years I see no sign that we have; if we have, it seems not to have led us to the discovery of anything fundamentally new or fundamentally important. It is safe to say that we have not asked the question—at all events not seriously. And it seems a bit strange that we have not; for many questions closely connected with it and naturally leading to it we have asked. Rudely reminded of the dismal things of human history, we have asked: What is the explanation of them? Can we prevent their recurrence? And, if so, how? Keenly aware of the present plight of the world, we have asked: What is the cause? Are we humans under the dominion of a malevolent fate? Or is there a cure? And, if there be a cure, what is the remedy? In trying to answer these great questions, we have been led to ask others—questions about ethical systems or ethical beliefs, about national or racial philosophies, about education, about industrial methods, about economics, about jurisprudence, political science and theories of government. We have beheld the amazing progress of invention, of natural science, of mathematics, and the technological sciences; we have seen their swift conquests of space, time, and matter; we have seen our globe thus rapidly reduced to the small dimensions of an ancient province; we have seen many peoples of divers tongues, traditions, customs and institutions consequently constrained to live together as in a single community; we have seen that there is thus demanded a new ethical wisdom, a new legal wisdom, a new educational wisdom, a new economical wisdom, a new industrial wisdom, a new political wisdom, a new wisdom in the affairs of government; for the new wisdoms our anguished times cry aloud; we have heard the answers—which are in the main but reverberated echoes of the wailing cry mingled with the chattering voices of excited public men who know not what to do; knowing that the welfare of the world, since it depends at once upon *all* the cardinal forms of human activity, demands team-work of them and therefore *equal* progressiveness in all of them, we have compared the swift advancement of the genuine sciences, on the one hand, with the slow, uncertain, halting pace of the so-called social sciences, on the other; we have been astounded by the contrast; in the crumpled and broken condition of our civilization we behold the appalling consequences of the mighty disparity; and so we have asked why it is that the social sciences—of ethics, education, jurisprudence, economics, politics, and government—have lagged so far behind the forward strides in the other great fields of human activity that the system of human relationships throughout the world has been strained and torn asunder like an immense network of wire rent by a cyclone. This very important question has led to some curious results. It has led to the invention of doctrines that alarm, to proposals that startle,—doctrines and proposals that we are wont to call radical, revolutionary, red. Is it true that our thinking has been too radical? The trouble is that, in the proper sense of that much abused term, our thinking has not been radical enough. Our questionings have been eager and wide-ranging but our thought has been shallow; it has been emotional and it has been daring but it has not been deep. We have indeed known that the character and status of the so-called human or social sciences depend upon what man *is*; but we have not reflected upon the fact that they depend also, in equal or greater measure, upon what we humans *think* man is. The fact of this fundamental dependence, had we considered it, would have led us to a further reflection—it would have led us to wonder whether the backwardness, the mediæval-mindedness, the disastrous lagging of the social sciences may not be due to their having at their base or in their heart a fundamentally false conception or false conceptions of what is really characteristic of humankind. It is evident that, if

our thinking had reached that point, we could not have failed to ask ourselves the supreme question: What is man?

Why have we not in these times asked that fundamental question? Doubtless it is because we have assumed, in the main unconsciously, that we know the answer. For why enquire when we are sure we know? Is our assumption of knowledge in this case just? Have we really known, do we know now, what is in fact the idiosyncrasy of the human class of life? Do we critically know what we, as representatives of man, really are? Here it is essential to distinguish; we are speaking of knowledge; there is a kind of knowledge that is instinctive—instinctive knowledge—immediate inner knowledge by instinct—the kind of knowledge we mean when we say that we know how to move our arms or that a fish knows how to swim or that a bird knows how to fly. I do not doubt that, in this sense of knowing, we do know what human beings are; it is the kind of knowledge that a fish has of what fishes are or that a bird has of what birds are. But there is another kind of knowledge—scientific knowledge—knowledge of objects by analyzing them—objective knowledge by concepts—conceptual knowledge of objects; it is the kind of knowledge we mean when we say that we know or do not know what a planet is or what a number is. Now, we do not suppose fish to have this sort of knowledge of fish; we do not suppose a bird can have a just conception—nor, properly speaking, any conception—of what a bird is. We are speaking of concepts, and our question, you see, is this: have we humans a just concept of man? If we have, it is reasonable to suppose that we inherited it, for so important a thing, had it originated in our time, would have made itself heard of as a grave discovery. So I say that, if we have a just concept of man, it must have come down to us entangled in the mesh of our inherited opinions and must have been taken in by us, as such opinions are usually taken in, from the common air, by a kind of "cerebral suction."

Well, what are the concepts of man that our generation has thus inherited? Broadly speaking, they are of two types. One of them is biological or zoological; the other one is mythological. Some of us hold the former one; some of us the latter; and some of us probably hold both of them; for, though they are mutually incompatible, mere incompatibility of two ideas does not necessarily prevent them from finding firm lodgment in the same brain. According to the zoological conception, man is an animal—a kind or species of animal. This conception has at least one merit—it regards human beings as natural—as creatures having a place in the scheme of nature. This merit the mythological conception has not; according to it, man has strictly no place in nature—he is indeed neither natural nor supernatural but is both at once—a kind of miraculous union, compound, or hybrid of the two. Such, then, are the concepts of man that now reign throughout the world and that have so reigned from time immemorial. And such are the concepts that have fashioned our so-called human or social sciences in so far as these have been and are fashioned by what we humans consciously or unconsciously *think* man is.

Are the concepts true? Or rather we must ask—since they can not both of them be true—is one of them true?

It should not amaze us to find that both are false; for the concepts are man's and their object is man; thus the difficulty is unique; it is that of a self-conscious being having to regard its kind as an object and rightly conceiving what the object is. In respect of the mythological conception, there are no doubt some who are disposed to treat it ironically as only the other day it was treated by Plato, for example. "We must accept," said he, "the traditions of the men of old time who affirm themselves to be the offspring of the gods—that is what they say—and they must surely have known their own ancestors. How can we doubt the word of the children of the gods? Although they give no probable or certain proofs, still, as they declare that they are speaking of what took place in their own family, we must conform to custom and believe them." But this gentle irony—the way

of the Greek philosopher—is not the way of the Polish engineer. The latter is not indeed without a blithesome sense of humor but in this matter he is tremendously in earnest; deeming it to be immeasurably important for all mankind, he treats it with the utmost seriousness; and he bluntly affirms, boldly and confidently, that neither the mythological conception nor the zoological conception of man is true; he denies outright that man is a species of animal and similarly denies that humans are compounds of natural and supernatural.

What is the error in those traditional conceptions? It is, he contends, of the same kind in both of them, and the kind is fundamental. It is the kind of error that consists in what mathematicians call confusion of types and what Korzybski calls mixing of dimensions. Let me explain; I have only to remind you of what everybody knows. And the simplest explanation is the best. You and I may speak of, say, the class of geometric points or of the class of spheres but we can not speak logically of a class composed of points *and* spheres for there is no such class; or we may speak of the class of water-drops or of the class of oceans but not logically of a class of water-drops *and* oceans; the types are different and must not be confused; to talk as if there were such a class is to talk nonsense, and it would be the same if we tried to discourse rigorously about a class composed of stars *and* rays of light; it would be to chatter as if there were no such thing as logic, or laws of thought. The matter is even clearer in terms of dimensions, or dimensionality; pardon me for dwelling upon it—it is so very important: here is a straight line—it has length only—it is a one-dimensional thing; it is not a point; it does contain points and it has some point properties, but, if on this account we called it a point, we should be guilty of a type-confusing blunder; next consider a surface, say a plane—it has length and breadth—it is a thing of two dimensions; it contains points and lines and it has certain point properties and certain line properties; but we do not call it a point or a line; if we did the blunder would be a dimension-mixing blunder; once more, here is a solid, say a cube —it has length, breadth and thickness—it has three dimensions; it has surfaces and it has certain surface properties, but it is not, therefore, a surface; if we called it a surface or if we were to say it is a surface mysteriously combined with some miraculous influence from outside the universe of space, then in either case we should be guilty of treason against the eternal law of types or dimensions.

In the light of such elemental considerations we are going to see very soon and, I hope, very clearly what kind of beings we humans are according to Korzybski's concept of man and at the same time why he condemns the traditional conceptions as false. Consider the great life classes of our world—consider their patent cardinal distinctions and relations candidly and open-mindedly; and let us begin with the class of plants. I offer, as I need offer, only a rude sketch. Plants, we say, are living things. How are they characterized as a class, positively and negatively? They take in, chemically transform, organize and appropriate the basic energies of sun, soil and air; but they have not the *autonomous* power to move about in space; together they constitute the lowest order or class or type or dimension of life—say, for convenience, the life dimension I; being, as indicated, binders of the basic energies of the world, the plants are, in Korzybski's nomenclature, the basic-energy-binding, or chemistry-binding, class of life. What of the animals? What, I mean, are we to say of the creatures traditionally designated as the "lower" animals? Like the plants, animals, too, take in, transform, organize and appropriate the energies of sun, soil and air, though in large part they take them already prepared by the plants; but unlike the plants, animals possess the *autonomous* power to move about in space—to creep or crawl or swim or run or fly; it is thus evident that, compared with plants, animals belong to a higher type or dimension of life—say the life dimension II; the classification we are here interested in, you see is broad; because they are distinguished by

their autonomous power to move, to abandon one place and occupy another and so to appropriate the natural fruits of many localities, the animals are called space-binders—the space-binding class of life.

And now we come to the crux. What are we to say of man? Like the animals, human beings have the autonomous power to move—the capacity for binding space—for taking now one and now another "place in the sun" with the goods thereof, and it is plain that, if human beings had no capacity of *higher* order, men, women, and children would indeed be animals. But what are the facts? Be good enough to examine them carefully; they are familiar; let us, if we can, reflect upon them as if they were unfamiliar, for that is half the secret of philosophy and of science, too. Long, long ago, a quarter or half million years ago, there came into existence upon this globe—no matter how—a new kind of beings; they did not know what they were; they knew nothing of the world, nothing of its size or shape or place in the universe, nothing of its resources, their locations or properties, nothing of natural law; they were without guiding maxims, precepts or precedents; they had no science, no philosophy, no art, no wealth, no instruments, no history—not even tradition: their ignorance was almost absolute; and yet, compared with the animals, which they hunted and which hunted them, they were marvels of genius; for there was in them a strange new gift—a strange new energy—that mysterious power in virtue of which they did that most wonderful of all things—*initiated* the creative movement called civilization. That power, first manifest in the infancy of our race, is the power that invents, the power that imagines, conceives, reasons; it is the power that makes philosophy, science, art and all the other forms of material and spiritual wealth; the power that detects the uniformities of nature, creates history, and foretells the future; it is the power that makes *progress* possible and actual, discerns excellence, acquires wisdom, and, in the midst of a hostile world, more and more determines its own destiny. The animals have it not or, if they have, they have it in a measure so small that we may neglect it as mathematicians neglect infinitesimals of higher order. Do not fail to observe *how it relates us to that mysterious thing called Time,* which so many thinkers—psychologists, philosophers, astronomers, physicists, and mathematicians—are just now as never before engaged in studying, each in his own way. By virtue of that familiar yet ever strange human power, each generation inherits the fruit of the creative toil of bygone generations, augments the inheritance, and transmits it to the generations to come; thus the dead survive in the living, destined with the living to greet and bless the yet unborn. If this be poetry it is also fact. Past, Present and Future are not three; in man they are spiritually united to constitute *one living* reality. And now we behold, and are at length prepared to grasp, Korzybski's great Concept. Because this capacity for binding time, under a law of ever-increasing amelioration, is *peculiar* to man or is at all events his in an incomparable degree, the class of human beings is to be conceived and scientifically defined to be the Time-binding class of life. We have here, you see, a new dimension, a new type, of life—life-in-Time. Animals are binders of space; man is a time-binder. Allow me a word of caution. Since, like the animals, man, too, binds space, may we not say that man is a time-binding animal? No; to say that would be the same kind of blunder as to say that a solid is a surface because it has surfaces and some surface properties or to say that fractions are a species of whole numbers because they happen to have some of the properties of whole numbers. It is fatal to confuse types, or to mix dimensions. Time-binding activity—the defining mark of man—may involve and often does involve space-binding as a higher involves a lower; but to say that, therefore, man is a species of animal—a time-binding species thereof—is like saying that a solid is a species of surface or that water is a species of oxygen or that wine is a species of water or that a violin is a species of wood

or that definite integration is a species of addition or that a symphony is just a species of sound.

Such, then, is the new conception of man—the conception of a being whose character and appropriate dignity consist in his peculiar capacity or power for binding time. The nobility of the conception is obvious, unmistakable. It has two other marks that belong to all really great ideas—it is intelligible to all and is universal in its interest and appeal. Your sense of its significance, if your experience repeats my own, will grow as you meditate upon it, for its significance, I do not doubt, is mighty. The author, I believe, is right in his belief that it marks the beginning and will guide the development of humanity's manhood. I wish it were possible to examine here some of its bearings on the cardinal interests of mankind; but "the hour contracts" and I can do no more than barely allude to a few salient considerations.

One of them is that, though we human beings are indeed not a species of animal, we are *natural* beings: it is as natural for us to bind time as it is natural for fishes to swim or birds to fly.

That fact is fundamental. Another one, also fundamental, is this: time-binding power—the characteristic of humanity—is not an effect of civilization but is its cause; it is not civilized energy, it is the energy that *civilizes;* it is not produced by wealth, whether material or spiritual, but is the source and creator of both.

I come now to the gravest of considerations. Inasmuch as time-binding is the characteristic of humanity, to study and understand man is to study and understand the nature of his time-binding energies; the laws of human nature are the natural laws of these energies; to discover these laws is a task of supreme importance for it is evident that upon the natural laws of time-binding must be based the future science and art of human life and human welfare.

One of the laws we already know—not indeed precisely—but fairly well—we know its general type—and it merits our best attention. It is the natural law of progress in time-binding, or civilization-building. Let us glance at it. Each generation of (say) beavers begins where the preceding generation began; that is a law for animals—there is no advancement, no time-binding—a beaver dam is a beaver dam. Contrast this with human life. Man invents and discovers and creates. An invention or discovery or creation once achieved, what happens? Each invention leads to new inventions, each discovery to new discoveries, each creation to new creations; invention breeds invention, science begets science, the children of knowledge and art and wisdom produce their kind in larger and larger families; each generation begins, not where its predecessor began, but where it ended; things done become instruments for the doing of better things; the Past survives in the living achievements of the dead; the body of these achievements—invention, science, art, wisdom—is the living capital of the ever passing Present, inherited to be held in trust for enlargement and for transmission to Future man; the process is that of time-binding: Past and Future are thus united in one eternal Now owning a law of perpetual growth and continual progress. What is the Law thereof—the natural law? You see at once what it is: it is that of a rapidly increasing geometric progression—if P be the progress made in a given generation, called the first, and if R be the ratio, then the progress made in the second generation is PR, that in the third PR^2, and that made in the single Tth generation will be PR^{T-1}. Observe that R is a large number and that the time T enters as an exponent—and so the expression PR^{T-1} is called an *exponential function of Time.* This is an amazing function; as T increases, the function not only increases but does so at a rate which itself increases according to a similar law, and the rate of increase of the rate of increase again increases in like manner, and so on endlessly, thus sweeping on towards infinity in a way that is truly marvelous. Yet that is the law—the natural law—for the advancement of civilization—

immortal offspring of the marriage of Time and human Toil.

And here arises a great question which I have hardly time enough to touch. The question is: Has civilization always advanced in accord with the mentioned law? And, if not, why not? The time-binding energies of man have been in operation long—300,000 to 500,000 years, according to the witness of human relics, ruins and records of the caves and the rocks. If progress had followed the mentioned law throughout that vast period, our planet would no doubt be now clothed with a civilization so advanced that we are powerless to imagine it or to conceive it or even to conjecture it in dreams. And yet that law is a natural law of the time-binding energies of man. What has been the trouble? What the main trouble has been is pretty plain. As already said, what we human beings do depends, not merely upon what we are but, in equal or greater measure, upon what we *think* we are. From time immemorial the characteristic energies of our humankind have been hampered by the false conception that man is a species of animal and hampered by the false conception that man is a miraculous mixture of natural and supernatural. Throughout the long period of our race's childhood, from which we have not yet emerged, those misconceptions have lain athwart the course of civilization. All that is precious in present civilization has been accomplished in spite of them. The goods, the glorious achievements, of which they have *deprived* the world, we can not now know but the subtle ramifications of their *positive* evil we can trace in a thousand ways. And it is your duty and mine to trace them. Whoever preforms the duty will be appalled. I can not dwell upon the matter here. Suffice it to say that, if we humans do not in fact constitute a perfectly natural class of life, then there never has been and never can be a human ethics having the understandability, the sanction and the authority of natural law; if we do constitute such a class of life but continue to *think* we do *not*, the result will be much the same—our ethics will continue to carry the confusion and darkness produced by the presence in it of mythological elements. If, on the other hand, human beings continue to regard man as a species of animal, then the social life of the world in all its aspects will continue to reflect the misconception; especially our ethics, which subtly pervades, colors and fashions all of the social sciences, will continue to be—what it always has been in large measure—a zoological ethics, animal ethics, the ethics of tooth and claw, space-binding ethics, the ethics of strife, violence, combat and war.

So it has been, but it will not continue so to be if we have the wisdom to learn the fundamental lesson of our recent experience. What is that lesson? It is this: the World War was an unforeseen, sudden, cataclysmic demonstration of human ignorance of human nature—a demonstration, pitiless as fate or famine, that human beings have never rightly conceived Man to be what Man is—not a mixture of natural and supernatural nor a species of animal, but the natural agency for those time-binding energies in the world whose peculiar function it is to produce civilization and to do so in conformity with its marvelous law of an increasing function of time.

That conception will be found, I believe, to initiate a new epoch—the epoch of humanity's manhood. The concept is easy to grasp—all, and especially the young, can understand it. Once it is understood, human life will accord with human nature, the time-binding energies will be freed from the old bondage, and civilization will at length advance in accord with its natural Law as the great forward-leaping exponential function of Time. There will be great changes and many transfigurations. Education—education in home, school and church—will have for its supreme function to teach the children of man what man is and what they are. Ethics will abandon the space-binding standards of animals and will become *human* ethics based upon the natural laws of the time-binding energies of man. Freedom will be freedom to live in accord with those laws and righteousness will

be the quality of life that does not contravene them. The social sciences of ethics, education, economics, politics and government will become what they never have been—genuine sciences; fashioned by a just conception of man, they will cooperate to fashion the state; and the state, which may ultimately embrace the world, will rescue itself from ignorant politicians and commit its destiny to the guidance of *honest* men who *know*.

And when guided by honest men who know—when guided, that is, by the coming science of human engineering, which will be intelligence applied to human affairs—when thus guided in the light of the true conception of man as the binder of time—then and only then our human civilization—the living issue of time-binding toil, mainly that of the dead—will advance, not haltingly as hitherto, but, as said, in accord with the natural law thereof, in a warless world, swiftly and endlessly.

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MENDELIAN OR NON-MENDELIAN?

IN 1907, several years after the Mendelian discoveries had begun to attract general interest, a writer endeavored to limit "Mendelian heredity" to the occurrence of 3 to 1 phenotypic ratios. All other ratios were held to represent other systems of inheritance. This extreme view was not held by any one actually engaged at that time in genetical investigations, and the paper referred to was entirely ignored by geneticists because its author was so obviously ignorant of the real implications of the Mendelian discoveries.

Recently, two of our foremost geneticists[1] have gone to the opposite extreme in stating what should be included in Mendelian heredity, declaring that "Mendelian heredity has proved to be the heredity of sexual reproduction; the heredity of sexual reproduction is Mendelian." Certainly few geneticists would at the present time include so much under the term "Mendelian heredity," though one,[2] at least, there is, who sympathizes with this dictum.

Between these extreme views as to the meaning to be attached to the expression "Mendelian heredity" different geneticists have taken different positions and even one and the same writer has given the term different meanings at different times. These differences of usage have led to misunderstandings and to some controversy.

Davis[3] has placed the mere occurrence of segregation in the Œnotheras equivalent to Mendelian inheritance, thus accepting the validity of a criticism made by East[4] based on the same conception as that quoted above from East and Jones, that all heredity in sexual reproduction is Mendelian. As I understand it, however, the occurrence or non-occurrence of segregation in the Œnotheras has never been an important issue; the real question has been whether the segregation which does quite obviously occur is of the Mendelian type, *i.e.*, whether the hereditary factors are distributed during gametogenesis and fertilization according to the formulation actually developed by Mendel in interpreting the results of his experiments.

Other writers[5] have grouped the phenomena of segregation under the terms "Mendelism" and "neo-Mendelism," but include under the latter name several phenomena which are now generally recognized among geneticists as differing in no essential way from the actual cases studied by Mendel. Still others speak of "orthodox" Mendelism, implying that there is also a "heterodox" Mendelism, or they use the expressions "strictly Mendelian,"

[1] East, E. M., and Jones, D. F., "Inbreeding and Outbreeding." 285 pp. Philadelphia: J. B. Lippincott Co., 1919. See p. 50.

[2] Wright, S., "Systems of mating. I. The biometric relations between parent and offspring." *Genetics*, 6: 111–123. 1921. See p. 111.

[3] Davis, B. M., "Hybrids of *Œnothera biennis* and *Œnothera franciscana* in the first and second generations," *Genetics*, 1: 197–251. 1916.

[4] East, E. M., "The Mendelian notation as a description of physiological facts," *Amer. Nat.*, 46: 633–655. 1912.

[5] Coulter, J. M., and Coulter, Merle C., "Plant Genetics." ix + 214 pp. Chicago: Univ. of Chicago Press. 1918. See pp. 40–96.

"typical Mendelian," etc. All such qualifying expressions give evidence of the recognition of the fact that usage varies regarding the significance of the words "Mendelism" and "Mendelian."

Since there are these differences of usage among geneticists, it would seem to be necessary for any one who describes a genetical situation as Mendelian or non-Mendelian, to state just what meaning is to be attached to the expression he uses. In my own usage of the expression "Mendelian heredity" it has always referred to cases such as Mendel actually observed, in which there is (statistically) independent segregation of unit factors during gametogenesis and chance recombinations at fertilization. I had this conception in mind in declaring[6] that the genetical phenomena in the Œnotheras are, with rare exceptions, non-Mendelian.

As Mendel never observed a case of linkage and no provision is made for such a phenomenon in the theory by which he interpreted his results, such cases are, on this basis, to be considered non-Mendelian,—especially as they definitely contradict the fundamental Mendelian postulate of *independent* segregation. This may perhaps with some justice be termed the strict-constructionist view. On the other hand, since it is now obvious that strictly Mendelian phenomena and linkage phenomena are products of the same mechanism and indeed that linked genes are in many cases quite indistinguishable from wholly independent ones, there is some justification for those who give a broader construction to the term Mendelian, making it essentially synonymous with chromosomal heredity as distinguished from cytoplasmic heredity.

In view of these discrepancies in usage by different authors, has not the time come to abandon the use of "Mendelian" and "non-Mendelian" as definite categories, and to adopt other terms which will have greater precision of meaning? It seems to me that the accumulation of facts from genetical investigations has reached such magnitude as to justify an attempt in this direction.

In offering a terminology for several of the fundamental categories of genetical phenomena my object is chiefly to emphasize by this means the fact that the categories themselves do exist and that they have been (and are) recognized by geneticists.

Very few (if any) geneticists will now fail to agree that the relation of hereditary factors to linkage groups, or to paired paternal and maternal material bodies, the chromosomes, must provide the basis for such a classification. Since we have long been familiar users of two words, homozygous and heterozygous, derived from the Greek root ζυγ- (ζεύγνυμι, to join, ζεῦξις, a yoking; ζυγόν, a yoke), it seems appropriate to use the same Greek root as the basis of the more complete terminology here suggested.

To distinguish between phenomena which are dependent upon the distribution of the chromosomes, and those phenomena which are to be referred to extra-chromosomal bodies or substances, we may use the nouns, *zeuxis* and *exozeuxis*, and corresponding adjectives *zygous* and *exozygous*. These alternatives correspond closely with chromosomal and cytoplasmic inheritance; but "exozeuxis" has an advantage over "cytoplasmic heredity," since some exozygous phenomena may conceivably be associated with nucleoplasmic structures or substances instead of the cytoplasm.

Under zeuxis or chromosomal heredity three fundamental relationships of hereditary factors are to be noted, depending on whether only one chromosome pair or linkage group is involved, or more than one, and whether the chromosomes concerned are behaving in typical or atypical fashion. These three categories may be named, respectively, *monozeuxis* (one pair involved), *pleiozeuxis* (two or more pairs involved), and *anomozeuxis* (involving chromosomal irregularities), and the corresponding adjectives will be *monozygous*, *pleiozygous* and *anomozygous*.

The last of these categories, anomozeuxis, is a composite made up of several phenomena

[6] Shull, G. H., "A peculiar negative correlation in Œnothera hybrids," *Jour. Genetics*, 4: 83–102. 1914.

of diverse nature, which have been occasionally lumped together under the expression "chromosome-exceptional," including non-disjunction (primary and secondary), triploidy, tetraploidy, etc., chromosome elimination, fragmentation, chromosomal fusions, rearrangements of whole chromosomes, or of genes in the chromosomes, etc.

Accepting the four categories represented by the terms monozeuxis, pleiozeuxis, anomozeuxis and exozeuxis, what is their relation to Mendelism? This question can be profitably discussed only if prefaced by a statement that Mendelism is here taken to include only the phenomena to which Mendel's interpretation applies, namely to the separation of each pair of alternative factors into equal numbers of germ cells in both sexes, and a purely chance assortment of the several alternatives among the several gametes, so that the permutational groupings of unit factors shall be potentially represented by equal numbers of germ cells.

Such behavior of the genes during gametogenesis provides for the production of the typical Mendelian ratios if there is neither selective fertilization nor selective elimination.

With this understanding of the phenomena to which the words "Mendelism" and "Mendelian" are appropriately applied, it will be obvious (1) that all zygous monohybrids are Mendelian. In other words, monozeuxis is Mendelian if only one pair of factors is concerned and the chromosome pair involved is behaving typically. (2) Monozygous dihybrids are likewise Mendelian whenever crossing over equals or exceeds 50 per cent. (3) All pleiozygous dihybrids or polyhybrids are Mendelian so long as no two factors in the series are monozygous with a frequency of crossing over lower than 50 per cent. (4) Anomozeuxis may under certain circumstances exhibit Mendelian phenomena. Thus in the case of non-disjunction, if the odd (unpaired) chromosome does not interfere with the normal disjunction of any other pair of chromosomes the genetical behavior with respect to qualities determined by the unpaired chromosome gives the results expected of a typical Mendelian monoheterozygote.

Non-Mendelian phenomena will be found (1) in monozygous dihybrids whenever crossing over is less than 50 per cent.; (2) in most cases of anomozeuxis, and (3) in all cases of exozeuxis.

In the Œnotheras where the question of Mendelian or non-Mendelian heredity has been most sharply and persistently raised, the situation seems now in fair way to be cleared up:

1. Exozeuxis is probably concerned in the inheritance of a variegation of the foliage which is occasionally found.

2. The *brevistylis* factor which has seemed thus far to be inherited independently of other known factors, probably represents, in relation to these other factors, a case of pleiozeuxis.

3. The occurrence of frequent irregularities in chromosome behavior (anomozeuxis) is illustrated (*a*) by the oft-repeated occurrence of the 15-chromosome forms, *albida, lata, semilata, scintillans, bipartita,* etc.; (*b*) the triploid or "*semi-gigas*" individuals sometimes called "heroes" because of their robust, *gigas*-like appearance; (*c*) the tetraploid *gigas;* and (*d*) by cases of probable fragmentation of chromosomes in forms with an extra diminutive chromosome.[7]

4. I now have on record data which demonstrate beyond question that the factors for the following characters are monozygous, being located in a single chromosome pair (chromosome I) and at a maximum distance of considerably less than 50 units: (*a*) *rubricalyx* bud pigmentation; (*b*) intense reddening of the stems; (*c*) *nanella* stature; (*d*) pink-coned buds; (*e*) *sulfurea* flower-color; and (*f*) and (*g*) two zygote lethals ("balanced"). As this group of characters makes up so large a block of those which have attracted the attention of geneticists, and as there are preliminary indications that still other factors are linked with the factors for

[7] Lutz, Anne M., "Œnothera mutants with diminutive chromosomes," *Amer. Jour. Bot.*, 3: 502–526. 1916.

the above-mentioned characters,—notably, (*h*) a pollen lethal, and (*i*) a factor for revolute leaves[8]—it can be safely stated that inheritance in the Œnotheras is comprised almost wholly in the two categories, anomozeuxis and monozeuxis, while pleiozeuxis seems at the present time to be exemplified clearly only by the relation between the factor for *brevistylis* and the other known factors, with the possibility that even *brevistylis* may one day be connected up with the same linkage group as the others, through the discovery of an intermediately placed gene.

On the whole it is now clear that while the genetical phenomena in the Œnotheras, with exception of the case of variegated foliage, can be referred definitely to the chromosomes (zeuxis), the occurrence of independent segregation which is necessary for the production of typical Mendelian behavior is so rare as to be almost negligible.

George H. Shull

Princeton University

[8] Since this was written the factor for revolute leaves has been fully demonstrated to lie in chromosome I at or very near the same level as the factor for *rubricalyx* buds and that for red stems.

SCIENTIFIC EVENTS

MEMORIAL TO JAMES ORTON

The governments of Bolivia and Peru have erected a monument to James Orton, the American explorer, whose grave is on Esteves island in Lake Titicaca. The funds for the memorial were given by the alumnae of Vassar College, where at the time of his death Dr. Orton was professor of natural history. The execution of the memorial was entrusted to John Ettl, the New York sculptor. It will be placed on the crest of the island which rises several hundred feet above the lake. The memorial is nine feet in height, circular in pattern with a square plinth, and in its ensemble suggests a tomb. The circular character was inspired by the tall shaft-like structures of the Incas. The dedicatory exercises will be held on September 25, the forty-fourth anniversary of Orton's death. The Peruvian Government will be officially represented, and a large attendance is expected from Arequipa, Peru and La Paz, Bolivia.

Miss Anna P. Orton, the daughter of the explorer, Mrs. Alice P. Sanford and Miss Ellen W. Farrar, Vassar alumnae, will represent the college. They take to the ceremony a stand of flags, including the Peruvian, Bolivian and American, presented by the United States Government.

James Orton was born at Seneca Falls, New York, April 21, 1830. He graduated from Williams College in 1855 and at Andover Theological Seminary in 1858. In 1866, he was appointed instructor in natural sciences in Rochester University. In 1867 a scientific expedition to the equatorial Andes and the River Amazon was organized under the auspices of the Smithsonian Institution, and Professor Orton was selected as its leader. The expedition sailed from New York on July 1, 1867, and after crossing the Isthmus of Panama, the route was from Guayaquil to Quito, over the Western Cordillera; thence over the Eastern Cordillera and through the forest on foot to the Napo; down the Rio Napo by canoe to Pebas, on to Marañon; and thence by steamer to Para, Brazil. As a result of this expedition many hitherto unknown specimens of natural history were collected and from portions of the collections in the museums of the Smithsonian Institution, the Philadelphia Academy of Natural Science, the Boston Society of Natural History, the Peabody Academy of Science, and Vassar College, while the bulk of the collection was purchased by Ingham University, Leroy, New York.

Upon his return to the United States in 1869, Professor Orton was offered the chair of natural history at Vassar College with which institution he remained until his death in 1877. In 1873 he made a second journey across South America from Para up the Amazon to Lima and Lake Titicaca, making valuable ethnological collections of Inca relics. In 1876 he organized a third expedition, with the object of exploring the great Beni River, a branch of the Madeira. This

expedition reached the mouth of the river, but much of the equipment and many supplies were lost. Orton, with a few companions, made the 600-mile journey back to La Paz through the forest and jungle amid incredible hardships. He died on crossing Lake Titicaca.

VACCINATION FOR SMALLPOX IN ENGLAND

THE London *Times* reports that at Nottingham, an epidemic of considerable proportions is now established; there have been 46 cases, 36 being unvaccinated, since the beginning of February. Last year a somewhat serious outbreak took place in Glasgow.

It is said that many towns in the country are badly protected at present for the doctrines of the opponents of vaccination have been widely spread. Of some areas it would be fair to say that they are destitute of protection. The population has simply refused vaccination *en masse*. An illustration—which is by no means exceptional—is Coventry, where the medical officer of health has issued the following figures:

Year	Births	Vaccinated, Percentage
1916	2,996	22.9
1917	2,738	13.0
1918	2,857	10.7
1919	2,429	8.7
1920	3,372	9.6

It was deliberate, as the following list makes quite clear:

Year	Declarations made of conscientious objections
1916	1,946
1917	1,830
1918	1,763
1919	1,250
1920	2,303

The medical officer points out that "this community is becoming largely an unvaccinated one."

What this may mean can be guessed from a series of figures published by the City of Liverpool in which the ravages of smallpox during the past 51 years are set down. The following are extracts:

Year	Deaths	Year	Deaths
1870	174	1883	26
1871	1,919	1884	106
1872	50	1885	46
1873	10	1886	29
1874	30	1887	1
1875	29	1888	1
1876	386	1889	1
1877	299	1890	None
1878	3	1891	2
1879	None	1892	13
1880	2	1893	9
1881	34	1894	20
1882	6	1895	12

The figures have remained very low since then except for the sharp epidemic of 1903 when there were 141 deaths. In 1918 there were only seven cases in England and Wales. But the sharp drop in vaccination of the past two years may be followed by a severe penalty.

THE WORK OF THE ROYAL OBSERVATORY AT THE CAPE OF GOOD HOPE

S. S. CLOUGH, H. M. astronomer at the Cape of Good Hope, has recently issued a report in which he gives an account of the distribution of the normal work of the observatory.

Dr. Halm exercises general supervision in all departments and takes part in heliometer observations and observations of an extra-routine character requiring special attention. He acts in full charge of the observatory during the absence of H. M. astronomer. Dr. Lunt is in charge of the Victoria telescope and its instrumental accessories, and of all photographic work in connection therewith.

Mr. Cox is in charge of the new meridian circle and of the time signal service, and supervises the reductions of all meridian observations. Mr. Woodgate is in charge of the astrographic telescope, photo-heliograph and seismograph, and of all photographic work connected therewith, and supervises the department of miscellaneous computations.

In addition to the above, a staff of fourteen computers and assistants is employed.

There are also attached to the observatory an instrument maker, an electric fitter, a stoker, a carpenter, and three Kroomen, who

act as messengers and keep the rooms and grounds in order.

Messrs. A. W. Long and J. F. Skjellerup, two voluntary observers, have undertaken a program of observations of variable stars, and an equatorial (either the 6-inch or the 7-inch) has been placed at their disposal as required for this purpose. The regular meridian observers during the year have been Messrs. Cheeseman, Wilkin, Peirce, Mullis, Duncan and Davis. The heliometer observations have been made by Messrs. Hough and Halm. The observations with the Victoria telescope have been made by Messrs. Lunt, Jackson and Baines, those with the astrographic telescope by Mr. Woodgate. Occasional observations of occultations, etc., have also been made by Messrs. Cox, Power and Pead.

THE INTERNATIONAL COMMISSION ON ILLUMINATION

The first technical session of the International Commission on Illumination, the successor of the International Photometric Commission, was held in Paris on July 4–8. According to the report of the meeting in *Nature* those interested in illumination problems in Belgium, France, Great Britain, Italy, Spain, Switzerland and the United States of America were represented at the session, which was opened by the Minister of Public Works, who welcomed the delegates in the name of the French Republic. The British delegates, nominated by the National Illumination Committee of Great Britain, were: Major K. Edgcumbe (Institution of Electrical Engineers, chairman of the National Committee), Mr. C. C. Paterson (hon. secretary and treasurer of the International Commission), Mr. A. P. Trotter (Illuminating Engineering Society), Dr. E. H. Rayner (National Physical Laboratory), Mr. L. Gaster (Illuminating Engineering Society), Mr. R. Watson (Institution of Gas Engineers), and Mr. J. W. T. Walsh (National Physical Laboratory, assistant secretary of the International Commission). The subjects dealt with by the commission were as follows: (1) The unit of candlepower at present in use in this country and in France and the United States was adopted for international purposes, and is to be known as the "international candle." It is maintained by means of electric incandescent lamps at the National Laboratories of the three countries named. (2) The definitions of the terms "luminous flux," "luminous intensity," and "illumination," and the units of these quantities, viz. the lumen, the candle, and the lux (meter-candle), were agreed upon. (3) The subjects of heterochromatic photometry (including physical photometry and the characteristics of the "normal eye"), factory lighting, and automobile head-lighting were also discussed at the meetings, and sub-committees were appointed to study the questions from the international point of view during the next three years. The new president of the commission is Dr. E. P. Hyde, director of the Nela Research Laboratories of America, and Major Edgcumbe is one of the three vice-presidents. The next meeting of the commission was provisionally arranged to be held in New York in 1924.

CHEMISTRY AND CIVILIZATION

The American Chemical Society, meeting this week in New York City, held on September 8 a session devoted to "Chemistry and Civilization." According to the announcement Dr. Edgar F. Smith, provost emeritus, University of Pennsylvania, would be in the chair, and the speakers were:

The rôle of chemistry, Dr. Chas. Baskerville, director of the Laboratories, College of the City of New York; chairman of the International Committee.

Energy; its sources and future possibilities, Dr. Arthur D. Little, chemical engineer and technologist, Boston.

The engineer; human and superior direction of power, Dr. Leo H. Baekeland, honorary professor of chemical engineering, Columbia University.

Chemistry and life, Sir William J. Pope, professor of chemistry, Cambridge University.

Theories, Dr. Willis R. Whitney, head of research department, General Electric Company.

Research applied to the world's work, Dr. C. E.

K. MEES, head of the research department, Eastman Kodak Company.

Problem of diffusion and its bearing on civilization, PROFESSOR ERNST COHEN, professor of chemistry, University of Utrecht.

Catalysis: the new economic factor, PROFESSOR WILDER D. BANCROFT, professor of physical chemistry, Cornell University.

SCIENTIFIC NOTES AND NEWS

DR. JOEL ASAPH ALLEN, curator of the Department of Birds and Mammals at the American Museum of Natural History since 1885, died at Cornwall-on-Hudson on August 29, aged eighty-three years.

As has already been noted in SCIENCE the Second International Congress of Eugenics, which will meet at the American Museum of Natural History, New York City, from September 22 to 28, will hold four sections. The opening addresses before the sections are announced as follows: The address before Section I, Human and Comparative Heredity, will be given by M. Lucien Cuénot, professor of zoology and physiology in the University at Nancy, France, on "Adaptation and Modern Genetic Conception"; before Section II., Eugenics and the Human Family, by Dr. Herman Lundborg, professor of psychiatry and neurology in the University of Upsala, Sweden, on "Eugenics and the Human Family." The address before Section III, Human Racial Differences, will be given by Georges Vacher de Lapouge, Poitiers, France, the title of whose address is still to be announced. The address before Section IV, Eugenics and the State, will be given by Major Leonard Darwin, of London, on "The Aims and Methods of Eugenical Societies."

THE annual summer meeting of the American Phytopathological Society was held in conjunction with the Conference of Cereal Pathologists at St. Paul, Minnesota and Fargo, North Dakota on July 19 to 22 inclusive. The following scientific men were present as invited guests of the society: Dr. E. J. Butler, Imperial Bureau of Mycology, London; Dr Kingo Miyabe, professor of botany and director of the Botanic Garden, Hokkaido Imperial University, Sapporo, Japan; Mr. R. J. Noble, and Mr. James P. Shelton, Department of Agriculture, New South Wales, Australia. Members of the society were present from Philippine Islands, from three provinces of Canada and from ten states. The meeting really constituted an international conference on cereal diseases. Drs. Butler and Miyabe will visit a number of institutions before returning home, and Mr. Noble and Mr. Shelton expect to remain for at least a year to engage in research. Professor A. Jaczewski, director of the Institute of Mycology and Phytopathology, Petrograd, Russia, and Professor N. I. Vavilov, Bureau of Applied Botany and Plant Breeding, Petrograd, Russia, arrived too late to attend the conference. They will make an extended tour of the United States and Canada before returning to Russia.

THE following honorary degrees were conferred upon members of the British Medical Association by the University of Durham on the occasion of the recent meeting of the association in that city:—*Doctor of Civil Laws:* Sir William MacEwen, Sir Thomas Oliver, and Sir Humphry D. Rolleston. *Doctor of Hygiene:* Dr. T. E. Hill and Dr. J. W. Smith. *Doctor of Science:* Sir Arthur Keith. *Doctor of Literature:* Sir Dawson Williams, editor of the *British Medical Journal. M.A.:* Dr. Alfred Cox, medical secretary of the association.

A MARBLE bust of Professor E. Fuchs, the Vienna ophthalmologist, was unveiled at the University of Vienna on June 14, the occasion being his seventieth birthday. He retired in 1915.

F. J. W. ROUGHTON, of Trinity College, Cambridge has been elected to the Michael Foster research studentship in physiology. The Raymond Horton Smith prize in medicine has been awarded to Dr. R. L. M. Wallis of Downing College.

DR. CHARLES-EDWARD AMORY WINSLOW, of Yale University, medical director of the American Red Cross, is in Geneva attending the meeting of the Health Commission of the

League of Nations. The commission plans to organize a world health institution separate from the International Health Office of the Red Cross, to which the United States belongs.

Dr. A. B. Stout, of the N. Y. Botanical Garden, has spent two weeks at the State Experimental Station at Geneva, N. Y., in making further study of flower types in grapes and in the work of breeding for seedless sorts of hardy grapes. This work is being done in cooperation with the Department of Horticulture of the Experimental Station.

Dr. Gustav T. Troedsson, privat-docent at the Geological Institute at Lund, Sweden, is accompanying Professor Percy E. Raymond, of Harvard University, on the third of the Shaler Memorial Expeditions for the study of the Ordovician in the southern Appalachians.

Dr. J. W. Kimball, formerly research chemist at Delta Laboratory, E. I. du Pont de Nemours and Co., Arlington, N. J., has joined the staff of the National Aniline and Chemical Co., as research chemist at their works at Marcus Hook, Pa.

We learn from *Nature* that a medal, to be known as the Meldola medal, will be presented annually by the Society of Maccabæans for the most noteworthy chemical work of the year carried out by a British subject who is not more than thirty years of age on completing the work. The award will be made by the council of the Institute of Chemistry acting with one member of the Society of Maccabæans, and power to vary the conditions of award is vested in the committee of the society and the council of the institute acting jointly. The object of instituting the medal is to recognize merit among the younger generation of chemists and to perpetuate the memory of Professor Raphael Meldola, the distinguished chemist who served as president both of the society presenting the medal and of the Institute of Chemistry. It is hoped that the first presentation will be made at the annual general meeting of the Institute of Chemistry on March 1, 1922.

At a meeting of the Royal College of Surgeons of Edinburgh, held on July 18, the president, Dr. George Mackay, presented to the College a portrait of the late Lord Lister. The picture is a full-sized copy made by Mr. Dorfield Hardy of the portrait painted by W. Ouless, R. A., in the possession of the Royal College of Surgeons of England. In accepting the portrait on behalf of the College, the vice-president, Dr. McKenzie Johnston, expressed the satisfaction the college had in acquiring this memorial of its most distinguished fellow through the generosity of their president.

The Priestley Memorial Committee of the American Chemical Society has reported that the sum of two thousand dollars has been collected and placed on interest. The committee has authorized the chairman to select an artist to copy the Stuart portrait of Priestley, which is now at Northumberland, Pa., and immediate steps will be taken to obtain a die for the Priestley medal.

Peter Cooper Hewitt, the electrical and mechanical engineer of New York City, died in Paris on August 25.

W. Horace Hoskins, professor of veterinary jurisprudence and dean of the New York State Veterinary College at New York University, died on August 17, aged sixty-one years.

W. E. Rolston, associated with Sir Norman Lockyer in the work of the Solar Physics Observatory at South Kensington until he enlisted in 1915, has died at the age of forty-five years.

UNIVERSITY AND EDUCATIONAL NEWS

The *Journal* of the Americal Medical Association states that members of the medical faculty of the University of Maryland Medical School, have placed their resignations in the hands of Dr. Albert F. Woods, president of the university. This action has been initiated by the medical men themselves in order that the faculty might be reorganized on a "half-time pay" basis. Plans for reorganization call for doubling the $500,000 a

year now expended by the hospital and medical school for running expenses, and providing a building fund of $1,000,000.

Dr. Lee I. Knight, of the department of botany, University of Minnesota, has been appointed chairman of that department.

Dr. Harry F. Lewis, A.B. and A.M., Wesleyan University, and Ph.D., Tilden, Illinois, has been elected associate professor in chemistry at Cornell College.

Dr. Joseph L. Mayer, chief chemist of the research and analytical laboratories of the Louis K. Liggett Co., New York, has been appointed professor of analytical and pharmaceutical chemistry in the Brooklyn College of Pharmacy where he has been associate professor of analytical chemistry for several years.

S. C. Ogburn, Jr., graduate of the University of North Carolina, has been appointed instructor in chemistry at Washington and Lee University.

James L. Howe, Jr., who has been for three years assistant professor of chemistry in Washington and Lee University, has accepted the professorship of chemistry in Hangchow Christian College, China.

H. P. Philpot, assistant professor at University College, London, has been appointed to the professorship of civil and mechanical engineering at the Finsbury Technical College; and A. J. Hale, chief assistant in the department of applied chemistry, has been appointed to the professorship in that department.

DISCUSSION AND CORRESPONDENCE

THE CHERT PITS AT COXSACKIE, N. Y.

A remarkable series of chert pits and two large quarries two miles south of Coxsackie, N. Y., is being examined by the archeological staff of the State Museum of New York under the leadership of State Archeologist Arthur C. Parker.

These pits are on the property of the West Shore Railroad and cover the greater portion of an elongate hill a mile in length and some one thousand feet in width. The hill is covered with the refuse of aboriginal excavations. The steep slopes are covered in places to a depth of six or more feet with the rock broken from the pits and quarries. One immense dump is more than a hundred feet long and eight feet in thickness and contains besides the waste rock the rejected blocks of flint and many broken or partially completed implements. Broken rock occurs in such quantities that the railroad purchased the property thinking it an enormous bed of broken stone suitable for road bed ballast.

Mr. Parker is making a survey of the hill in order to make a relief model of it for a museum exhibit. The artificial nature of the broken stone was discovered by Mr. Jefferson Ray, of West Coxsackie, who made a collection of 1,500 chipped chert implements from the workshop sites on the flats below the hill.

The site is an exceedingly old one and must have been worked by three or four hundred Indians at a time for a period of 500 to 1000 years, judging from the large quantities of flint found upon it. The site is a remarkable one and is a unique archeological monument that will well repay visitation by archeologists and geologists interested in securing data bearing on the stone age.

Everett R. Burmaster

State Museum,
Albany, N. Y.

THE USE OF AGAR IN FACILITATING THE REMOVAL OF A SWALLOWED FOREIGN OBJECT

Opportunity of experimentation and observation in the use of agar in assisting in the removal of a foreign object from the stomach came to the writer in the case of a child, four and one half years old, who had swallowed a safety pin. The pin was an ordinary nickeled pin, one and one half inches long, and was closed.

According to the best medical practise the use of purgatives or cathartics in such emergency is to be avoided, as such would tend to liquefy and remove the bowel content leaving the object unsupported; and moreover any

purgative acting by irritation of the bowels might cause such peristalsis as to allow the pin to become caught in the contracting action in such a manner as to become permanently imbedded. The removal by natural action is deemed best, aided by the feeding of much bulky food to stimulate natural peristaltic action, and to form encasement for the foreign object.

In accordance with these principles the child was induced to eat as much bulk-forming food as possible, as shredded wheat, oatmeal, bread and milk, potatoes, carrots, spinach and celery. Milk was allowed after the appetite had become satiated with the solid food.

In order to make more certain the removal of the object, as well as to hasten the action, it was conceived that the addition of agar to the diet would be highly beneficial. Since agar is not digested and swells to several times its bulk its effect would be not only to hasten peristalic action by natural stimulation, but its added bulk would assist in encasing the object and in carrying it along. It was reasoned that its effect would be of especial value in those portions of the digestive tract in which the digestible food is in the state of emulsification.

At evening and morning meals therefore, there was added to a little of the prepared cereal, three heaping teaspoonfuls of chocolate-coated granular agar. This was eaten by the child readily and with relish.

As the child tended somewhat toward constipation, the removal of the previous fecal matter was hastened by the use of a glycerol suppository. The later actions were wholly normal. The first feeding occurred in the evening, soon after the swallowing of the object. Bowel action occurred as follows: 16 hours, 23 hours, 40 hours, at which time the pin appeared. The stools were copious and of a moist, compact, firm structure—an ideal consistency to carry a foreign object. As bowel action occurred twice daily, instead of the usual once; and as the bulk of each was at least twice normal; it is evident that the bowel content had been increased by fourfold, due in a large measure to the agar.

It is not to be supposed that the safe removal of the object was due wholly to the agar, though this probably at least hastened its removal. As the experiment was wholly satisfactory however it would lead to the recommendation of the use of agar for this purpose. In the case of the removal of objects more dangerous, or more difficult of removal, it might prove a decisive factor.

LeRoy S. Weatherby

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AN INCONSISTENCY IN TAXONOMY

In the classification of animals we are often very inconsistent in the use and evaluation of characters as we apply them to different groups. This is more apparent between widely separated groups than closely related ones. Thus in the subgroups in one class of the vertebrates, osteological or other anatomical characters may be largely used, while in another class such internal characters may be almost entirely subordinated to external ones. Sometimes, to be sure, certain characters have not the same value in one class that they have in another, but the main reason for the inconsistency lies in the less skilful or less thorough handling of one group as compared with another. The truth is, classification became unfashionable long before the groups, especially the larger ones, were well formulated. Among groups as small as genera there are probably few cases so extreme as the following.

There are two genera of sharks, *Mustelus* and *Cynias*, that are strikingly similar in all external characters. We refer them to different genera because they differ in regard to a modification of the yolk sac in the young. In *Mustelus* the yolk sac is modified to function as a placenta by which the young forms a connection with the walls of the mullerian duct of the mother. This so-called placenta is absent in *Cynias*, or, more correctly speaking, the yolk sac is unmodified.

On the other hand, we place two mackerel together in the genus *Scomber* even though

one of them possesses an entire organ that is absent in the other. *Scomber scombrus* is without a swim bladder; *Scomber japonicus* has a well-developed one.

This is a most glaring inconsistency. On one hand, to separate two genera on the basis of a mere modification of an organ that is possessed by both of them, and on the other hand, to include in one genus two forms, one of which possesses an organ that is absent in the other. Making this inconsistency more marked is the fact that in the case of the sharks it is only during a part of the life of the animals (when they are with young) that the character of the 'placenta,' upon which the genus is based, can be ascertained. In the mackerel the presence or absence of the swim bladder can be seen at any time by simply opening the abdominal cavity.

On the whole, workers in vertebrate taxonomy seem to be more chary than those in invertebrate, in making use of internal characters in classification. The fact that a character is not readily apparent should not influence its use if animals are to be arranged in their true relationship.

Such a marked structural difference as the possession of an organ as compared with the suppression of it certainly should be considered of generic weight. Therefore it would seem well to raise the subgenus *Pneumatophorus* Jordan and Gilbert, to generic rank. The American species, *Scomber colias* and *S. japonicus*, would thus stand *Pneumatophorus colias* and *P. japonicus*.

EDWIN C. STARKS

AN IMPROVED METHOD OF ESTIMATING THE NUMBER OF GENETIC FACTORS CONCERNED IN CASES OF BLENDING INHERITANCE

DR. SEWALL WRIGHT has kindly pointed out an error in the formula which I recently suggested[1] in connection with this subject. Instead of taking the direct difference between the standard deviations of F_1 and F_2, as I did, one should deal with the difference between the *squared* standard deviations. Dr. Wright bases this correction on his discussion of the fundamentals of factorial theory as developed particularly in "Systems of Mating IV.," *Genetics*, 6, March, 1921. He gives the correct formula for the number of factors (n) concerned in a case of blending inheritance as

$$n = \frac{D^2}{8(\sigma_2^2 - \sigma_1^2)},$$

in which D is the difference between the means of the parental races, σ_1 is the standard deviation of F_1, and σ_2 is the standard deviation of F_2. This method gives in general a smaller number of genetic factors than the method which I suggested, and its use is simpler. Applied to the examples which I cited, it gives, in the case of seed weight of maize, 4 or 5 factors instead of "about 15"; and in the case of weight of rabbits in three different crosses, 3, 14 and 22 or 23 factors, instead of 56, 80, and 176, respectively. I am greatly indebted to Dr. Wright for the correction.

W. E. CASTLE

[1] SCIENCE, July 29, 1921.

THE CURVE OF DISTRIBUTION

TO THE EDITOR OF SCIENCE: An explanation of the irregularities in the curve of the distribution of the heights of 221,819 men, taken from insurance statistics, to which Professor Boring called attention in SCIENCE for November 12, 1920, may possibly be found in the nature of the measuring devices used by the examining physicians. One of the three leading types on the market and at least one other are graduated in inches alone instead of in feet and inches. The tendency for men who use these scales to read off the round number, 70 inches, instead of 69, and 60 inches instead of 59, might be great enough to account for the "bumps" in the Gaussian curve at 5 ft. 10 in. and at 5 ft.; and the lowering of the average height which would result from the correction of these exaggerations might change the ideal curve sufficiently to bring the bump at 5 ft. 8 in. within the normal limits of error for a curve whose unit of measurement is so large in comparison to the total range of variation.

CARL H. P. THURSTON

PASADENA, CALIF.

QUOTATIONS

DYES FOR BACTERIOLOGY

Bacteriologists in this country and in the United States of America are anxious about the supply of chemical dyes used in their work. Animal tissues and the microbes which may infest them, as seen under the microscope, present to the eye an almost uniform appearance of pale translucency. A skilled treatment with dyes and mordants reveals the otherwise invisible differences of structure and composition. Particular cells and granules, bacteria and spores, have affinities for particular stains, and betray their presence by the colors they absorb. The presence, the quality, and even the phase of an infection or of a morbid state are thus detected, and the processes are a necessary part of research, diagnosis, and treatment. But the reactions are delicate, and their value depends on a high purity and standardization of the reagents employed. The materials are almost entirely the aniline dyes used in textiles. Before the war Grübler in Germany had examined these and selected those that might be of use to biologists. The total bulk of the trade is very small, and the German manufacturer had taken so much trouble to standardize his products and secure their purity that he had a practical monopoly and was able to charge a high but legitimate price. When the war came, in 1914, a few fortunate institutions had in hand a stock of the Grübler reagents sufficient to meet their wants. But the greater number of biologists were soon in difficulties. Here and in the United States several manufacturers, partly from patriotic motives and partly from the attraction of the great difference in price between the crude textile dyes and the microscope stains, began to supply the demand. There is no reason to suppose that their output was inferior to the German products. But it varied from manufacturer to manufacturer in its precise qualities. The users got results which were not exactly comparable with those obtained from the Grübler products or with each other. The total demand, moreover, is so small in bulk that it is hardly worth distributing. The situation has given rise here and in America to a desire for the free importation of German bacteriological stains, on the one hand, and, on the other, to fresh efforts to maintain national independence in this branch of scientific work. The Society of American Bacteriologists is endeavoring to secure cooperation in determining on a reliable standard brand of each kind of stain, and in discouraging the marketing of variants. A similar course in this country would be very convenient.—The London *Times*.

SPECIAL ARTICLES

THE SECOND-YEAR RECORD OF BIRDS WHICH DID AND WHICH DID NOT LAY DURING INDIVIDUAL MONTHS OF THE PULLET YEAR

The egg output of the commercial poultry plant is due in part to birds in their first and in part to birds in their second year. At some time during the first year the number of pullets is reduced to the number which is to be retained as hens during the second year.

It would be of obvious advantage if the birds sold from the flock as pullets could be those which if retained would make the poorest record in their second year. If the birds destined to be the highest producers in the second year could be selected on the basis of some criterion recognizable in the first year, it should be possible to raise the average production of the flock as a whole by increasing the average production of the hens.

In the course of a general investigation of the problem of the prediction of the egg production of the domestic fowl from the records of short periods, we have availed ourselves of the opportunity of considering the relationship between first and second year laying activity presented by the data of the Vineland International Egg Laying and Breeding Contest. As one phase of this work[1] we have sought to determine to what extent the simple criterion of *laying* versus *not laying* in any month of the first year may be used

[1] Other phases of the investigations will be reported in detail elsewhere.

in predicting the record of the second year. The criterion has already been considered in relation to the prediction of first year egg record.[2] While our immediate purpose is the consideration of the second year production of birds which did and of those which did not lay during given months of the first year, it seems desirable to give the mean first year productions of these birds as well. For comparison the results deduced from the data

[2] Harris, Blakeslee and Kirkpatrick, *Genetics*, 3: 42–44, 49–56, 1918.

MEAN ANNUAL PRODUCTION FOR FIRST AND SECOND YEAR FOR BIRDS WHICH DID AND WHICH DID NOT LAY DURING INDIVIDUAL MONTHS OF THE FIRST YEAR

Condition of bird in month of first year	Storrs data for first year		Vineland data for first and second year		
	Per cent. of flock	First year annual mean	Per cent. of flock	First year annual mean	Second year annual mean
November					
Not laying	40.6	136.8	19.4	144.5	127.8
Laying	59.4	164.2	80.6	181.2	142.7
Difference		+ 27.4 17.9%		+ 36.7 21.1%	+ 14.9 10.7%
December					
Not laying	38.0	133.6	22.3	142.3	125.9
Laying	62.0	165.2	77.7	183.2	143.8
Difference		+ 31.6 20.6%		+ 40.9 23.9%	+ 17.9 12.8%
January					
Not laying	42.5	136.4	20.5	141.6	124.4
Laying	57.5	165.6	79.5	182.4	143.8
Difference		+ 29.2 19.1%		+ 40.8 23.4%	+ 19.4 13.9%
February					
Not laying	9.9	118.6	5.0	133.6	117.0
Laying	90.1	157.0	95.0	176.2	141.0
Difference		+ 38.4 25.1%		+ 42.6 24.5%	+ 24.0 17.2%
July					
Not laying	2.3	72.3	3.1	110.6	92.5
Laying	97.7	155.1	96.8	176.1	141.3
Difference		+ 82.8 54.1%		+ 65.5 37.6%	+ 48.8 34.9%
August					
Not laying	5.1	89.9	7.2	121.6	99.5
Laying	94.9	156.5	92.8	178.1	142.9
Difference		+ 66.6 43.5%		+ 56.5 32.5%	+ 43.4 31.0%
September					
Not laying	23.0	115.0	33.2	147.8	124.3
Laying	77.0	164.6	66.8	187.1	147.5
Difference		+ 49.6 32.4%		+ 39.3 22.6%	+ 23.2 16.6%
October					
Not laying	54.7	131.9	63.2	156.9	129.8
Laying	45.3	178.9	36.8	203.5	157.0
Difference		+ 47.0 30.7%		+ 46.6 26.8%	+ 27.2 19.5%

of the International Egg Laying Contest at Storrs during the year 1913–'14 and 1914–'15 [3] are laid beside those presented here from the Vineland data.

The essential constants appear in the accompanying table. This gives the per cent. of the flock which did and which did not lay during the months of the first year in which any considerable proportion of the birds did not lay. The average annual production for these birds in the first year of both the Storrs (1913–'14 and 1914–'15) and the Vineland (1916–'17) contests and in the second year (1917–'18) of the Vineland contest are shown. While the actual differences in egg preduction are the data of practical significance, comparison between the three series is facilitated by expressing the differences between these annual means for the birds of the two classes as percentages of the actual annual average productions[4] of the flock.

Considering first the records of the pullet year we note that for the Storrs series the birds which laid in any given month show an average annual (pullet year) egg production of from 27.4 to 82.8 eggs higher than those which did not lay or from 17.9 to 54.1 per cent. For the Vineland series the difference in the production of the two groups ranges from 36.7 to 65.5 eggs or from 21.1 to 37.6 per cent. Thus the difference in the annual egg production of the birds which did and which did not lay in any given month, as well as the percentage of the birds which are not laying, varies greatly according to the month considered. During the months of November, December and January the percentage differences in the annual production of the two groups of birds is higher in the Vineland than in the Storrs series whereas for the other months of the eight considered the reverse is true. The average percentage difference is 30.4 in the Storrs series and 26.6 in the Vineland series.

[3] Harris, Blakeslee and Kirkpatrick, *loc. cit.*, p. 42.

[4] These are 153.19 eggs for the first year at Storrs, 174.05 eggs for the first year at Vineland, and 139.79 eggs for the second year at Vineland.

Thus the constants show conspicuous differences of great practical significance in the first (pullet) year records of birds which did and those which did not lay during the individual months of the first year. The results for the first year records at Storrs and the first year records at Vineland are in fair agreement.

Turning to the second year means we note that for each of the eight months of the first year used as a basis of selection for an increase of second year preduction, the second year record of birds is higher if they laid during the special month under consideration in the first year than if they did not lay in that month. The differences between the groups amount to about two dozen eggs or more per bird in five of the eight months considered.

It is clear, therefore, that so simple a criterion as laying *vs.* non laying in the first year may furnish a criterion of some value for the selection of the birds to be retained in the flock for breeding and for second year production.

J. Arthur Harris,
Harry R. Lewis

THE AMERICAN CHEMICAL SOCIETY

(continued)

DIVISION OF INDUSTRIAL AND ENGINEERING CHEMISTRY

H. D. Batchelor, *chairman*
H. E. Howe, *secretary*

Symposium on Drying. Charles O. Lavett, *chairman*

The rate of drying of solid materials: W. K. Lewis.

The theory of atmospheric evaporation: W. H. Carrier.

The compartment dryer: W. C. Carrier and A. E. Stacey. A discussion of the relative merits of the continuous and compartment dryers.

Direct heat rotary drying apparatus: R. G. Merz. The paper was treated under the following heads: (1) The kinds and characteristics of direct heat rotary dryers. (2) The fields of application of such drying apparatus to the industries where they can be used to advantage. (3) The

advantages and limitations of these machines. (4) Efficiency is dependent upon the physical characteristics of the material to be handled, the initial and final moisture contents, the kind of fuel employed and the method of application of the drying medium. (5) When use of waste heat from other processes is advisable and economical.

Tunnel dryers: Grahame B. Ridley. For the purposes of this paper, tunnel dryers are limited to those having material on trays which are moved progressively through a tunnel which is supplied with a current of heated air from which all the heat used for drying is obtained and by which all the moisture is removed. Details of their operation were described.

The spray process: R. S. Fleming.

Vacuum drying: Chas. O. Lavett and D. J. Van Marle. The paper gave an outline of the principles of vacuum drying, in particular the heat transmission and the influence of the vacuum on the temperature and rate of evaporation. A more detailed description was given of the vacuum shelf, rotary and drum dryer, their construction, application and cost of operation.

Tests on counter-current kelp driers: G. C. Spencer and E. B. Smith. Details were given of tests made at the kelp-potash plant of the U. S. Bureau of Soils at Summerland, Calif., during the year 1918.

The preparation, properties and constitution of liquid and solid water-glasses: Louis Schneider. Liquid water-glass may be prepared by a number of methods, of which the furnace process is at present the most widely employed in this country. Solid water-glass may be produced by dehydration, hydration, synthetic and crystallization methods. A practical crystallization method is unfortunately limited to the meta-silicate ratio. A continuous dehydration method at atmospheric pressure offers the best means of attaining a stable and completely soluble water-glass at a low cost. A number of important properties of liquid and solid water-glasses, as well as of sodium meta-silicate crystals and silicic acid hydrogels, have been fully described. It has been shown that solution and not dilution occurs when a solid water-glass is mixed with water. Viscosity is mainly a function of the sodium meta-silicate content. The free causticity of concentrated liquid water-glasses may be ascertained by the attainment of the heat of solution of a hydrated silica in the concentrated liquid water-glass and in a dilute caustic soda solution. It has been established (*a*) that a liquid water-glass is primarily a solution of sodium meta-silicate, silicic acid and, if the maximum solubility of the latter is exceeded, silicic acid hydrogel; and (*b*) that a solid water-glass, above the ratio of 1 Na_2O : $1SiO_2$, is a mixture of hydrated sodium meta-silicate and an incompletely dehydrated silicic acid hydrogel. A system of nomenclature has been proposed to eliminate the prevalent indefiniteness of the terms employed in the literature and the trade.

Method for treating filter cake obtained in refining vegetable and animal oils: Charles Baskerville. According to the Baskerville process, vegetable and animal oils are refined by treating with caustic, a determined amount of cellulose such as paper pulp or "linters" being mixed in with the oil, and heating to a "break." The soap particles are hardened and colloids are agglomerated by the further addition of anhydrous sodium sulphate or sodium carbonate. The insoluble mass thus produced is filtered out. The filter cake obtained may be subjected to squeezing in another press whereby some whole oil is recovered and a more compact cake results. The author also devised a process for recovering the remaining whole oil and the fatty acids in the cake. It depends upon cooking up the cake with an acid solution and running the completely disintegrated acid mass, the linters or paper pulp forming a filtering medium, which makes a complete separation of the hot mixture of free fatty acids and water solutions of salts and acids from the fiber. The free fatty acids and the whole oils rise to the top of the mixture and may be separated by any of several well-known methods, washed with hot water, the product being thus converted into a soap making material containing approximately fifty per cent. free fatty acids and fifty per cent. whole oil. A patent covering the process has been applied for.

The application of the Cottrell precipitator to the wood distillation process: L. F. Hawley and H. M. Pier. Recent experiments on a wood distillation retort holding about 75 pounds of wood have shown that the Cottrell precipitator can remove from the vapors coming from the retort practically all of the tar. The pitch formed during the distillation of the wood is non-volatile and is carried over to the condenser in the form of a fog of fine particles. If the precipitator is kept at too high temperature the pitch precipitated is so hard that it builds up across the tubes and causes short

circuiting. If, however, the precipitator is operated at a temperature near the boiling point of water a certain amount of oil and water is precipitated with the pitch so that a thin liquid is precipitated which does not cause short circuiting. By the application of the precipitator in this way it is hoped to be able to provide a pyroligneous acid direct from the condenser in sufficient purity so that it will not have to be redistilled to remove the tar.

Alcohol and chemical industries: J. M. Doran. The present and future development of our chemical industries, notably our dye industry, is intimately bound up with our alcohol industry. The eighteenth amendment to the Constitution and the Volstead Act affect this key industry far more vitally than the average chemist is aware. Title III. of the National Prohibition Act accords special treatment under the law to industrial alcohol but overshadowing all are the prohibition features of Title II. of the same act wherein alcohol is defined as intoxicating liquor and subject to the restrictions surrounding intoxicating liquor. In order to free the alcohol industry and dependent and allied chemical industries from the strangling rules surrounding liquor under which no industry can prosper, it is of utmost importance that alcohol be divested of its beverage character. The handling and use of pure alcohol in any industry is now a liability rather than an asset. Under the denaturing provisions of the National Prohibition Act it is possible both to enforce prohibition and assure the healthy development of industrial alcohol. The solution of this problem is essential if we are to have a healthy chemical industry.

The caustic calcination of dolomite and its use in sorrel cements: G. A. Bole and J. B. Shaw. Magnesium limestones can not be burned successfully by present methods as the calcium carbonate gives rise to free lime which is detrimental to the sorrel reaction. The pressure of carbon dioxide may be so regulated as to prevent the liberation of free lime. An oxide produced at 700 to 750° C. is superior to that burned at any other temperature-data given. All dolomites do not act alike in calcining but some dissociate at a much lower temperature than others. The conclusion is drawn that when properly burned, *i.e.,* temperature and pressure controlled, some dolomites, but not all, will produce an oxide well suited for stucco mixes.

Valuation of oil-bearing seeds by free fatty acid of the oil: Lehman Johnson. The petrolic ether extract from 16 grams of cotton seed thoroughly dried at 103° C. was titrated for free fatty acid and found to bear a true relation to the free fatty acid of the hydraulically expressed oil. This test will serve to determine the quality and proximate refining loss where the alkaline method of refining is to be employed on the oil. It is suggested as a more scientific and fairer method of valuing cotton seed than the "out and count" of damaged seed method now in use. It is probably applicable to other oil-bearing seeds.

The detection of carbon monoxide: C. R. Hoover. Carbon monoxide reacts at ordinary temperature with mixtures of iodine pentoxide and fuming sulfuric acid to give carbon dioxide and iodine or compounds of oxides of iodine and sulfur. With excess of sulfur trioxide colors are obtained varying with the concentration of carbon monoxide from pale green to dark brown. This reaction has been applied to the detection of carbon monoxide and other reducing gases. In the laboratory simple apparatus enables one to determine carbon monoxide quantitatively when present in amounts varying from .01 per cent. to 1 per cent. Two simple portable devices have been constructed by means of which an approximate quantitative determination of carbon monoxide from .03 per cent. to 1 per cent. can be carried out in thirty seconds.

Microscopic illumination with reference to Brownian movement and combination lightning: A. Silverman. Brownian movement can be studied against a black background by direct illumination from a ring lamp surrounding the objective. This results in a marked contrast and gives unusual definition to the particles. Second, the use of combination lighting from the ring lamp for opaque objects imbedded in transparent media results in the desired contrast between the object and medium and shows the details of the object itself by the reflected light. This is accomplished by placing the concave mirror parallel to the stage of the microscope so that the light travels through the transparent medium to the substage reflector and is sent up again to produce the contrast. The details in the opaque object are obtained by the direct light from above.

The relation of structures to free alkali in sodium silicate solutions: William Stericker. Although the general opinion is that solutions of sodium silicate contain large quantities of free alkali, they probably do not. The misconception is due to a lack of a satisfactory method for the determination of the degree of hydrolysis. Ultramicroscopic examination proves that sodium silicate

solutions are two-phase systems in which the dispersed phase has a negative charge. Probably hydroxyl ions are absorbed on the particles and attract sodium ions to form double layers which cause higher concentrations of alkali at the interfaces than elsewhere in the solution. This hypothesis explains discrepancies between the results from various methods.

Compression evaporation: A new method of concentrating liquids developed in Europe recently: GUSTAV CARLSSON.

Action of lime on greensand: R. NORRIS SHREVE. The Eastern Potash Corporation has under construction at New Brunswick, N. J., a large plant for obtaining caustic potash and other potash compounds from greensand. The main reaction in the process is the action of lime in decomposing greensand whereby caustic potash is liberated and a valuable residue obtained, which possesses considerable cementitious properties. In the reaction the lime attacks the greensand, or rather the glauconite contained therein, when heated with the greensand in the presence of water and at elevated temperatures and under sufficient pressure to keep the water in the liquid phase.

A modification of the acetate method for estimating iron and albumen in phosphates: F. P. VEITCH and H. P. HOLMAN. As a result of co-operative work with the fertilizer division of the American Chemical Society and also independent investigations, certain modifications have been made in the acetate method for estimating iron and aluminum in the presence of lime and phosphoric acid. This method, in substantially its present form, was submitted by the authors to the committee on research and analytical methods of the fertilizer division and was published as a part of that committee's report on phosphate rock in *Journal of Industrial and Engineering Chemistry,* 7, pp. 446–448. The present article made further modifications as a result of subsequent work, discussed the reasons for the conditions described as necessary for accurate results by this method, and gave results obtained on solutions of known compositions.

The water resistance of treated canvas during continuous exposure to weather: F. P. VEITCH and T. D. JARRELL. This paper gives a detailed report on the water resistance of gray 12 oz. U. S. standard army duck, which had been treated with eighteen formulas developed in the Bureau of Chemistry. The degree of water resistance was determined in the laboratory by modified funnel and modified spray methods and also in actual service by exposure to weather for 14 months. General conclusions are drawn as to the effectiveness of the various treatments. The treatments which have proved most serviceable by exposure test have also given high results by the funnel test. However, not all treatments showing a high rating by the funnel test have proven highly serviceable in those cases where water lay for some time on the canvas.

The detection and estimation of coal tar oils in turpentine: V. E. GROTLISCH and W. C. SMITH. The method outlined includes the following steps: (1) passing dry hydrogen chloride gas into the liquid, thus converting the pinene into crystalline pinene hydrochloride, also raising the boiling points of the unprecipitated reaction products; (2) distillation of the filtrate under reduced pressure to separate the coal tar oils with a minimum of terpene bodies; (3) sulphonation of the distillate with fuming sulphuric acid, thereby destroying terpenes and converting coal tar hydrocarbons into sulphonic acids; (4) dilution and steam distillation of the sulphonation mixture to remove undecomposed terpenes or mineral oils; (5) direct distillation of the sulphonation mixture to break up the sulphonic acids, with recovery of the coal tar hydrocarbons.

CHARLES L. PARSONS,
Secretary

THE ROYAL SOCIETY OF CANADA

THE following papers were presented before the Mathematical, Physical and Chemical Section of the Royal Society of Canada at the meeting held in Ottawa on May 18, 19 and 20:

Presidential Address.—"Division in relation to the algebraic numbers," by Professor J. C. Fields. "Ionization potential and the size of the atom," by Professor A. S. Eve. "Detection of variation in electric earth currents by coil and galvanometer," by Professor A. S. Eve and Mr. E. S. Biehler. "The effective range of beta-rays," by Miss V. Douglas and Dr. J. A. Gray. "The velocity of sound in air and soil; Properties of x-rays excited by beta-rays; The absorption of gamma-rays; A note on the examination of materials by x-rays," by Dr. J. A. Gray. "The transmission of heat through the thin boundary films of air or of water at the surface of glass," by Dr. A. Norman Shaw and Mr. L. S. Smith.

"The viscosity of ether at low temperatures and solution of acetic acid in liquid hydrogen bromide," by Dr. E. H. Archibald, Mr. C. E. Stone and Mr. E. M. White. "Preliminary report on the lubricating properties of the different series of hydrocarbons," by Dr. W. F. Seyer. "An automatic mercury pump," by Dr. D. F. Steadman. "Some results of the destructive distillation of British Columbia alder and Douglas fir," by Mr. W. A. Hardy. "On the variation of the 'emanating power' of certain uranium minerals with temperature and a new secondary radium emanation standard," by Dr. J. H. L. Johnstone. "The effect of thermo-luminescence on electrical conductivity," by Mr. C. A. Mackay. "The anemometer factor; pilot balloon methods in Canada," by Mr. J. Patterson. "On some new formulæ for the direct numerical calculation of the coefficient of mutual induction of coaxial circles;" "On a new high frequency vibration galvanometer;" "On the photographic recording and measurement of radiotelegraph signals;" "On a new lecture room illustration of atomic models," by Dr. Louis V. King. "On the refractive indices of metallic vapors," by Professor J. C. McLennan. "On the absorption spectrum of liquid and gaseous oxygen," by Mr. W. W. Shaver. "On the structure of the Balmer series lines of hydrogen," by Professor J. C. McLennan and Mr. P. Lowe. "On the spectrum of helium, hydrogen and carbon in the extreme ultraviolet," by Professor J. C. McLennan and Mr. P. A. Petrie. "On the liquefaction of hydrogen," by Professor J. C. McLennan. "Nitrophthalic anhydrides and acetylamino-phthalic anhydrides with toluene and aluminium chlorides," by Mr. W. A. Lawrence. "Bromphthalic anhydrides with benzene and aluminium chloride," by Mr. H. N. Stephens. "The effect of certain chemicals on the rate of reproduction of yeast," by Mr. N. A. Clark. "The passage of hydrogen and of helium through silica tubes," by Professor J. B. Ferguson and Mr. G. A. Williams. "The action of methyl-green on yeast," by Mr. W. B. Leaf. "Pressure-volume relations of superheated liquids," by Mr. K. L. Wismer. "Scattering of light by dust-free liquids," by Mr. W. H. Martin. "Note of Wolski's paper on optically empty liquids," by Professor F. B. Kenrick. "Redetermination of the melting point of sodium chloride," by Professor J. B. Ferguson. "Researches in physical and organic chemistry carried out in the chemical laboratory of the University of Toronto," communicated by Professor W. Lash Miller. "On the reduction of the circulants to polynominal form with applications to the circulants of the 7th and 11th degrees," by Dr. J. C. Glashan. "The gravitation potential of an anchor ring; some tidal problems," by Professor A. H. S. Gillson. "Law of distribution of particles in colloidal solutions," by Professor E. F. Burton and Miss E. S. Bishop. "Production of heat during charcoal absorption," by Mr. Stuart McLean. "The relation between coagulative power of electrolytes and concentration of colloidal solutions," by Professor E. F. Burton and Mr. E. D. MacInnes. "The radial velocities of 570 stars;" "The orbit and dimensions of TV Cassiopeae;" "The temperature control of the stellar spectrograph," by Dr. J. S. Plaskett. "The orbital elements of the brighter components of Boss 497;" "The orbits of spectroscopic components of Boss 4622," by Mr. W. E. Harper. "The intensity distribution in typical stellar spectra," by Mr. H. H. Plaskett. "The solution of plane triangles by nomographic charts," by Dr. S. D. Killam. "Note on the geometrical equivalence of certain invariants," by Dr. Charles T. Sullivan. "The interpolation of breaks in tide curves for recording gauges," by Dr. W. Bell Dawson. "The vertical movement of alkali under irrigation in heavy clay soils;" "Notes on the nature of burn-outs," by Dr. Frank T. Shutt and Miss Alice H. Burwash. "Reversible pendulum," by Professor H. F. Dawes. "Characteristic x-rays from boron," by Professor A. L. Hughes. "A new experiment in vibration," by Professor John Satterly. "Note on the spectra of potassium;" "Note on infra-red spectroscopy," by Professor J. C. McLennan. "Selected radiation emitted by specially excited mercury atoms," by Mr. H. J. C. Ireton.

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SCIENCE

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ADDRESS OF THE PRESIDENT OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

THE British Association for the Advancement of Science owes its origin, and, in great measure, its specific aims and functions, to the public spirit and zeal for the interests of science of Scotsmen. Its virtual founder was Sir David Brewster; its scope and character were defined by Principal Forbes. In constitution it differed from the migratory scientific associations existing on the Continent, which mainly served to promote the social intercourse of their members by annual gatherings, in that it was to be a permanent organization, with a settled establishment and headquarters, which should have not merely its yearly reunions, but which, "by methods and by influence peculiarly its own, should continue to operate during the intervals of these public assemblies, and should aspire to give an impulse to every part of the scientific system; to mature scientific enterprise; and to direct the labors requisite for discovery."

Although, for reasons of policy, it was decided that its first meeting of September 27, 1831, should be held at York, as the most central city for the three kingdoms, and its second and third meetings at the ancient Universities of Oxford and Cambridge respectively, it was inevitable that the association should seize the earliest opportunity to visit the metropolis of Scotland where, as an historical fact, it may be said to have had its origin.

The meeting in this city of September 8, 1834, was noteworthy for many reasons. It afforded the first direct proof that the association was fulfilling its purpose. This was shown by the popular appreciation which attended its activities, by the range and charac-

[1] Read at the Edinburgh meeting, September 7, 1921.

ter of its reports on the state and progress of science, by the interest and value of its sectional proceedings, and by the mode in which its funds were employed. In felicitous terms the president of the preceding year, the Rev. Professor Sedgwick, congratulated the gathering "on the increased strength in which they had assembled, in a place endeared to the feelings of every lover of science by so many delightful and elevating recollections, especcially by the recollection of the great men whom it had fostered, or to whom it had given birth." In a few brief sentences Professor Sedgwick indicated the great power which this association is able to apply towards the advancement of science by combination and united action, and he supported his argument by pointing to the results which it had already achieved during the three short years of its existence. Professor Sedgwick's words are no less true to-day. His contention that one of the most important functions of this philosophical union is to further what he termed the "commerce of ideas" by joint discussions on subjects of kindred interest, has been endorsed by the recent action of the council in bringing the various sections into still closer touch with each other with a view to the discussion of common problems of general interest. This slight reorganization of the work of the sections, which is in entire accord with the spirit and aims of the association, as defined by its progenitors and formulated in its constitution, will take effect during the present meeting. Strictly speaking, such joint sectional discussions are not unknown in our history, and their utility and influence have been freely recognized. But hitherto the occasions have been more or less informal. They are now, it is hoped, to be part of the regular official procedure of the meetings, to which it is anticipated they will afford additional interest and value.

Another noteworthy change in our procedure is the introduction of discussions on the addresses of the presidents of sections. Hitherto these addresses have been formally read and never discussed. To the extent that they have been brief chronicles of the progress of the special departments of science with which the section is concerned they have given but little opportunity for discussion. With the greatly increased facilities which now exist for every worker to keep himself informed of the development of the branch of knowledge in which he is more particularly interested, such *résumés* have in great measure lost their true purpose, and there has, consequently, been a growing tendency of late years for such presidential addresses to deal with contemporary topics of general interest and of fundamental importance, affording ample opportunity for a free exchange of opinion. The experiment will certainly conduce to the interest of the proceedings of the sections, and will contribute to the permanent value of their work. We see in these several changes the development of ideas connected with the working of the association which may be said to have had their birth at its first meeting in Edinburgh, eighty-seven years ago.

Sixteen years later, that is on July 21, 1850, Edinburgh again extended her hospitality to the British Association, which then honored itself by electing the learned principal of the United Colleges of St. Salvator and St. Leonard, St. Andrews, to the presidential chair—at once a tribute to Sir David Brewster's eminence as a natural philosopher, and a grateful recognition of his services to this body in suggesting and promoting its formation.

On the occasion of his inaugural address, after a brief account of recent progress in science, made with the lucidity of expression which characterized all the literary efforts of the learned biographer of Newton and versatile editor of the *Edinburgh Encyclopedia*, the *Edinburgh Magazine*, and the *Edinburgh Journal of Science*, the president dwelt upon the beneficent influence of the association in securing a more general attention to the objects of science, and in effecting a removal of disadvantages of a public kind that impeded its progress. It was largely to the action of the association, assisted by the writings and personal exertions of its members, that the government was induced to extend a direct na-

tional encouragement to science and to aid in its organization.

Brewster had a lofty ideal of the place of science in the intellectual life of a community, and of the just position of the man of science in the social scale. In well-weighed words, the outcome of matured experience and of an intimate knowledge of the working of European institutions created for the advancement of science and the diffusion of knowledge, he pleaded for the establishment of a national institution in Britain, possessing a class of resident members who should devote themselves wholly to science—with a place and station in society the most respectable and independent—"free alike," as Playfair put it, "from the embarrassments of poverty or the temptations of wealth." Such men, "ordained by the state to the undivided functions of science," would, he contended, do more and better work than those who snatch an hour or two from their daily toil or nightly rest.

This ideal of "combining what is insulated, and uniting in one great institution the living talent which is in active but undirected and unbefriended exercise around us," was not attained during Brewster's time; nor, notwithstanding the reiteration of incontrovertible argument during the past seventy years, has it been reached in our own.

I have been led to dwell on Sir David Brewster's association with this question of the relations of the state towards research for several reasons. Although he was not the first to raise it—for Davy more than a century ago made it the theme of presidential addresses, and brought his social influence to bear in the attempt to enlist the practical sympathy of the government—no one more consistently urged its national importance, or supported his case with a more powerful advocacy, than the principal of the University of Edinburgh. It is only seemly, therefore, that on this particular occasion, and in this city of his adoption, where he spent so much of his intellectual energy, I should specially allude to it. Moreover, we can never forget what this association owes to his large and fruitful mind. Every man is a debtor to his profession, from which he gains countenance and profit. That Brewster was an ornament to his is acknowledged by every lover of learning. That he endeavored to be a help to it was gratefully recognized during his lifetime. After his death it was said of him that the improved position of men of science in our time is chiefly due to his exertions and his example.

I am naturally led to connect the meeting of 1850 with a still more memorable gathering of this association in this city. In August, 1871—just over half a century ago—the British Association again assembled in Edinburgh under the presidency of Lord Kelvin—then Sir William Thomson. It was a historic occasion by reason of the address which inaugurated its proceedings. Lord Kelvin, with characteristic force and insistence, still further elaborated the theme which had been so signal a feature of Sir David Brewster's address twenty years previously: "Whether we look to the honor of England," he said, "as a nation which ought always to be the foremost in promoting physical science, or to those vast economical advantages which must accrue from such establishments, we can not but feel that expermiental research ought to be made with us an object of national concern, and not left, as hitherto, exclusively to the private enterprise of self-sacrificing amateurs, and the necessarily inconsecutive action of our present governmental departments and of casual committees."

Lord Kelvin, as might have been anticipated, pleaded more especially for the institution of physical observatories and laboratories for experimental research, to be conducted by qualified persons, whose duties should be not teaching, but experimenting. Such institutions as then existed, he pointed out, only afforded a very partial and inadequate solution of a national need. They were, for the most part, "absolutely destitute of means, material, or *personnel* for advancing science, except at the expense of volunteers, or of securing that volunteers should be found to continue such little work as could then be carried on."

There were, however, even then, signs that the bread cast upon the waters was slowly re-

turning after many days. The establishment of the Cavendish Laboratory at Cambridge, by the munificence of its then chancellor, was a notable achievement. Whilst in its constitution as part of a university discipline it did not wholly realize the ideal of the two presidents, under its successive directors, Professor Clerk-Maxwell, the late Lord Rayleigh, and Sir J. J. Thomson, it has exerted a profound influence upon the development of experimental physics, and has inspired the foundation of many similar educational institutions in this country. Experimental physics has thus received an enormous impetus during the last fifty years, and although in matters of science there is but little folding of the hands to sleep, "the divine discontent" of its followers has little cause for disquietude as regards the position of physics in this country.

In the establishment of the National Physical Laboratory we have an approach to the ideal which my predecessors had so earnestly advocated. Other presidents, among whom I would specially name the late Sir Douglas Galton, have contributed to this consummation. The result is a remarkable testimony to the value of organized and continuous effort on the part of the British Association in forming public opinion and in influencing departmental action. It would, however, be ungrateful not to recall the action of the late Lord Salisbury—himself a follower of science and in full sympathy with its objects—in taking the first practical steps towards the creation of this magnificent national institution. I may be allowed, perhaps, to refer to this matter, as I have personal knowledge of the circumstances, being one of the few survivors of the committee which Lord Salisbury caused to be formed, under the chairmanship of the late Lord Rayleigh, to inquire and report upon the expediency of establishing an institution in Great Britain upon the model of certain state-aided institutions already existing on the continent, for the determination of physical constants of importance in the arts, for investigations in physical problems bearing upon industry, for the standardization and verification of physical instruments, and for the general purposes of metrology. I do not profess to give the exact terms of the reference to the committee, but, in substance, these were recognized to be the general aims of the contemplated institute. The evidence we received from many men of science, from departmental officers, and from representatives of engineering and other industrial establishments was absolutely unanimous as to the great public utility of the projected laboratory. It need hardly be said that the opportunity called forth all the energy and power of advocacy of Lord Kelvin, and I well remember with what strength of conviction he impressed his views upon the committee. That the National Physical Laboratory has, under the ability, organizing power, and business capacity of its first director, Sir Richard Glazebrook, abundantly justified its creation is recognized on all hands. Its services during the four years of war alone are sufficient proof of its national value. It has grown to be a large and rapidly increasing establishment, occupying itself with an extraordinary range of subjects, with a numerous and well-qualified staff, engaged in determinative and research work on practically every branch of pure and applied physics. The range of its activities has been further increased by the establishment since the war of coordinating research boards for physics, chemistry, engineering and radio-research. Government departments have learned to appreciate its services. The photometry division, for example, has been busy on experiments on navigation lamps for the Board of Trade, on miners' lamps for the Home Office and on motor-car head-lamps for the Ministry of Transport, and on the lighting of the National Gallery and the Houses of Parliament. Important work has been done on the forms of ships, on the steering and manœuvring of ships, on the effect of waves on ship resistance, on the interaction between passing ships, on seaplane floats, and on the hulls of flying-boats.

It is also actively engaged in the study of problems connected with aviation, and has a well-ordered department of aerodynamical research.

It can already point to a long and valuable

series of published researches, which are acknowledged to be among the most important contributions to pure and applied physics which this country has made during recent years.

I may be pardoned, I hope, for another personal reference, if I recall that it was at the Edinburgh meeting, under Lord Kelvin's presidency, fifty years ago, that I first became a member of this association, and had the honor of serving it as one of the secretaries of its chemical section. Fifty years is a considerable span in the life of an individual, but it is a relatively short period in the history of science. Nevertheless, those fifty years are richer in scientific achievement and in the importance and magnitude of the utilitarian applications of practically every branch of science than any preceding similar interval. The most cursory comparison of the state of science, as revealed in his comprehensive address, with the present condition of those departments on which he chiefly dwelt, will suffice to show that the development has been such that even Lord Kelvin's penetrative genius, vivid imagination, and sanguine temperament could hardly have anticipated. No previous half-century in the history of science has witnessed such momentous and far-reaching achievements. In pure chemistry it has seen the discovery of argon by Rayleigh, of radium by Madame Curie, of helium as a terrestrial element by Ramsay, of neon, xenon, and krypton by Ramsay and Travers, the production of helium from radium by Ramsay and Soddy, and the isolation of fluorine by Moissan. These are undoubtedly great discoveries, but their value is enormously enhanced by the theoretical and practical consequences which flow from them.

In applied chemistry it has witnessed the general application of the Gilchrist-Thomas process of iron-purification, the production of calcium cyanamide by the process of Frank and Caro, Sabatier's process of hydrogenation, a widespread application of liquefied gases, and Haber's work on ammonia synthesis—all manufacturing processes which have practically revolutionized the industries with which they are concerned.

In pure physics it has seen the rise of the electron theory, by Lorentz; Hertz's discovery of electro-magnetic waves; the investigation of cathode rays by Lenard, and the elucidation of crystal structure by Bragg.

It has seen, moreover, the invention of the telephone, the establishment of incandescent lighting, the electric transmission of force, the invention of the cinematograph, of wireless telegraphy, the application of the Röntgen rays, and the photographic reproduction of color.

In physical chemistry it has witnessed the creation of stereo-chemistry by Van't Hoff and Le Bel, Gibbs's work on the phase rule, Van't Hoff's theory of solutions, Arrhenius's theory of ionic dissociation, and Nernst's theory of the galvanic cell.

Such a list is far from complete, and might be greatly extended. But it will at least serve to indicate the measure of progress which the world owes to the development and application during the last fifty years of the two sciences —physics and chemistry—to which Lord Kelvin specially referred.

The more rapid dissemination of information concerning the results of recent or contemporary investigation, which Lord Kelvin so strongly urged as "an object to which the powerful action of the British Association would be thoroughly appropriate," has been happily accomplished. The timely aid of the association in contributing to the initial expense of preparing and publishing monthly abstracts of foreign chemical literature by the Chemical Society is gratefully remembered by British chemists. The example has been followed by the greater number of our scientific and technical societies, and the results of contemporary inquiry in every important branch of pure and applied science are now quickly brought to the knowledge of all interested workers. In fact, as regards the particular branch of science with which I am more directly concerned, the arrangements for the preparation and dissemination of abstracts of contemporary foreign chemical literature are proving to be a veritable embarrassment of riches, and there is much need for cooperation

among the various distributing societies. This need is especially urgent at the present time owing to the greatly increased cost of paper, printing, binding, and indeed of every item connected with publication, which expense, of course, ultimately falls upon the various societies and their members. The problem, which has already received some attention from those entrusted with the management of the societies referred to, is not without its difficulties, but these are not insoluble. There is little doubt that a resolute and unanimous effort to find a solution would meet with success.

The present high cost of book production, which in the case of specialized books is about three times what it was in 1914, is exercising a most prejudicial effect upon the spread of scientific knowledge. Books on science are not generally among the "best sellers." They appeal to a comparatively limited and not particularly wealthy public, largely composed of the professional classes who have suffered in no small measure from the economic effects of the war. The present high price of this class of literature is to the public detriment. Eventually it is no less to the detriment of the printing and publishing trades. Publishers are well aware of this fact, and attempts are being made by discussions between employers and the executives of the Typographical Association and other societies of compositors to reach an equitable solution, and it is greatly to be hoped that it will be speedily found.

All thinking men are agreed that science is at the basis of national progress. Science can only develop by research. Research is the mother of discovery, and discovery of invention. The industrial position of a nation, its manufactures and commerce, and ultimately its wealth, depend upon invention. Its welfare and stability largely rest upon the equitable distribution of its wealth. All this seems so obvious, and has been so frequently and so convincingly stated, that it is superfluous to dwell upon it in a scientific gathering to-day.

A late distinguished admiral, you may remember, insisted on the value of reiteration. On this particular question it was never more needed than now. The crisis through which we have recently passed requires it in the interests of national welfare. Of all post-war problems to engage our serious attention, none is more important in regard to our position and continued existence than the nation's attitude toward science and scientific research, and there is no more opportune time than the present in which to seek to enforce the teaching of one of the most pregnant lessons of our late experience.

It is, unfortunately, only too true that the industrial world has in the past underrated the value of research. One indication that the nation is at length aroused to its importance is to be seen in the establishment of the Department of Scientific and Industrial Research, with its many subordinate associations. The outbreak of the Great War, and much in its subsequent history, revealed, as we all know, many national shortcomings, due to our indifference to and actual neglect of many things which are at the root of our prosperity and security. During the war, and at its close, various attempts, more or less unconnected, were made to find a remedy. Of the several committees and boards which were set up, those which still exist have now been coordinated, and brought under the control of a central organization—the Department of Scientific and Industrial Research. Research has now become a national and state-aided object. For the first time in our history its pursuit with us has been organized by government action. As thus organized it seeks to fulfil the aspirations to which I have referred, whilst meeting many of the objections which have been urged against the endowment of research. It must be recognized that modern ideas of democracy are adverse to the creation of places to which definite work is not assigned and from which definite results do not emanate. This objection, which strikes at the root of the establishment of such an institution as Sir David Brewster contemplated, is, to a large extent, obviated by the scheme of the Department of Scientific and Industrial Research. It does not prescribe or fetter research, but, whilst aiding by personal payments the individual worker, leaves him free to pursue his inquiry

as he thinks best. Grants are made, on the recommendation of an advisory council of experts, to research workers in educational institutions and elsewhere, in order to promote research of high character on fundamental problems of pure science or in suitable cases on problems of applied science. Of the boards and committees and similar organizations established prior to or during the war, or subsequent to it, with one or two exceptions, all are now directly under the department. They deal with a wide range of subjects, such as the Building Research Board, established early in 1920 to organize and supervise investigations on building materials and construction, to study structural failures, and to fix standards for structural materials. The Food Investigation Board deals with the preservation by cold of food, and with the engineering problems of cold storage, with the chemistry of putrefaction, and the agents which induce it, with the bionomics of moulds, and the chemistry of edible oils and fats. The Fuel Research Board is concerned with the immediate importance of fuel economy and with investigations of the questions of oil-fuel for the navy and mercantile marine, the survey of the national coal resources, domestic heating, air pollution, pulverized fuel, utilization of peat, the search for possible substitutes for natural fuel oil, and for practicable sources of power alcohol.

The Geological Survey Board has taken over the Geological Survey of Great Britain and the control of the Museum of Practical Geology. The maintenance of the National Physical Laboratory, originally controlled by a general board and an executive committee appointed by the president and council of the Royal Society, is now transferred to the Department of Scientific and Industrial Research. A Mines Research Committee and a Mine Rescue Apparatus Committee are attached to the department. The former is concerned with such questions as the determination of the geothermic gradient, the influence of temperature of intake and return air on strata, the effect of seasonal changes on strata temperature of intakes, the cooling effect due to the evolution of fire-damp, heat production from the oxidation of timber, etc. The department is also directing inquiries on the preservation and restoration of antique objects deposited in the British Museum. It is concerned with the gauging of rivers and tidal currents, with special reference to a hydrographical survey of Great Britain in relation to the national resources of water-power. In accordance with the government policy, four coordinating boards have been established to organize scientific work in connection with the fighting forces, so as to avoid unnecessary overlapping and to provide a single direction and financial control. The four boards deal, respectively, with chemical and physical problems, problems of radio-research, and engineering. These boards have attached to them various committees dealing with special inquiries, some of which will be carried out at the National Physical Laboratory. The government have also authorized the establishment of a Forest Products Research Board.

The department is further empowered to assist learned or scientific societies and institutions in carrying out investigations. Some of these were initiated prior to the war, and were likely to be abandoned owing to lack of funds. Whenever the investigation has a direct bearing upon a particular industry that had not hitherto been able to establish a research association, it has been a condition of a grant that the institution directing the research should obtain contributions towards the cost on a £ for £ basis, either directly through its corporate funds or by special subscriptions from interested firms. On the formation of the appropriate association the research is, under suitable safeguards, transferred to it for continuance. The formation of a number of research associations has thus been stimulated, dealing, for example, with scientific instruments, non-ferrous metals, glass, silk, refractories, electrical and allied industries, pottery, etc.

Grants are made to research associations formed voluntarily by manufacturers for the purposes of research, from a fund of a million sterling, placed at the disposal of the research department for this purpose. Such associa-

tions, to be eligible for the grant, must submit articles of association for the approval of the department and the Board of Trade. If these are approved, licenses are issued by the Board of Trade recognizing the associations as limited liability companies working without profits. Subscriptions paid to an association by contributing firms are recognized by the Board of Inland Revenue as business costs of the firms, and are not subject to income or excess profits taxes. The income of the association is similarly free of income tax. Grants are ordinarily made to these associations on the basis of £1 for every £1 raised by the association between limits depending upon the particular industry concerned. In the case of two research associations grants are made at a higher rate than £ for £, as these industries are regarded as having a special claim to state assistance on account of their "pivotal" character. The results of research are the sole property of the association making them, subject to certain rights of veto possessed by the department for the purposes of ensuring that they are not communicated to foreign countries, except with the consent of the department, and that they may be made available to other interested industries and to the government itself on suitable terms.

These arrangements have been found to be generally satisfactory, and at the present time twenty-four of such research associations have been formed to whom licenses have been issued by the Board of Trade. Others are in process of formation, and may be expected to be at work at an early date. These research associations are concerned with nearly all our leading industries. The official addresses of most of them are in London; others have their headquarters in Manchester, Leeds, Sheffield, Birmingham, Northampton, Coventry, Glasgow, and Belfast.

The department has further established a Records Bureau, which is responsible for receiving, abstracting, filing and collating communications from research workers, boards, institutions, or associations related to or supervised by the department. This information is regarded as confidential, and will not be communicated except in writing, and after consultation with the research worker or organization from which it has been received. Also such non-confidential information as comes into the possession of the department which is of evident or probable value to those working in touch with the department is collected and filed in the bureau and made generally available.

It is also a function of the bureau to effect economy in preventing repetition and overlapping of investigations and in ensuring that the fullest possible use is made of the results of research. Thus, the programmes of research associations are compared in order to ensure that researches are not unwittingly duplicated by different research associations. Sometimes two or more research associations may be interested in one problem from different points of view, and when this occurs it may be possible for the bureau to arrange a concerted attack upon the common problem, each research association undertaking that phase of the work in which it is specially interested and sharing in the general results.

As researches carried out under the department frequently produce results for which it is possible to take out patents, careful consideration has been given to the problems of policy arising on this subject, and other government departments also interested have been freely consulted. As the result, an interdepartmental committee has been established with the following terms of reference:—

1. To consider the methods of dealing with inventions made by workers aided or maintained from public funds, whether such workers be engaged (*a*) as research workers, or (*b*) in some other technical capacity, so as to give a fair reward to the inventor and thus encourage further effort, to secure the utilization in industry of suitable inventions and to protect the national interest, and

2. To outline a course of procedure in respect of inventions arising out of state-aided or supported work which shall further these aims and be suitable for adoption by all government departments concerned.

About forty patents have been taken out by the department jointly with the inventors and

other interested bodies, but of these, nine have subsequently been abandoned. At least five patents have been developed to such a stage as to be ready for immediate industrial application.

It will be obvious from this short summary of the activities of the department, based upon information kindly supplied to me by Sir Francis Ogilvie, that this great scheme of state-aided research has been conceived and is administered on broad and liberal lines. A considerable number of valuable reports from its various boards and committees have already been published, and others are in the press, but it is, of course, much too soon to appreciate the full effects of their operations. But it can hardly be doubted that they are bound to exercise a profound influence upon industries which ultimately depend upon discovery and invention. The establishment of the department marks an epoch in our history. No such comprehensive organization for the application of science to national needs has ever been created by any other state. We may say we owe it directly to the Great War. Even from the evil of that great catastrophe there is some soul of goodness would we observingly distil it out. T. EDWARD THORPE

(To be concluded)

LIFE IN OTHER WORLDS

DOES life—especially intelligent life—exist elsewhere than on the earth? Three letters in recent numbers of SCIENCE discuss this age-old problem. And it is noticeable that, as usual, the astronomers take the affirmative and the biologists the negative side of the argument. There may be two reasons for this.

1. Astronomers, physicists, mathematicians, are accustomed to hold a more receptive attitude, an open mind, toward hypotheses that can not be definitely disproved. This frame of mind is natural and adapted to their work. They are accustomed to deal with problems which can be solved by mathematical and deductive methods. A limited number of solutions appear, all of them to be receptively considered until they can be definitely disproved.

The biologist, on the other hand, deals with a different sort of problem. His evidence is almost always inductive, experimental. His subjects are far too complex, too little understood, to admit of mathematical analysis, save in their simpler aspects. And always he is compelled to adopt toward the illimitable numbers of possible explanations, a decidedly exclusive attitude, and to leave out of consideration all factors that have not something in the way of positive evidence for their existence. If he fails to do so, he soon finds himself struggling hopelessly in a bog of unprofitable speculations. A critical rather than a receptive frame of mind is the fundamental condition of progress in his work.

2. The second reason is that the astronomer or cosmologist has in mind when he thinks of this problem, the physical and chemical conditions that would render life possible. If these be duplicated elsewhere he sees life as possible, and by the incidence of the laws of chance probable or almost certain, if they be duplicated often enough. Viewing the innumerable multitude of stars, each of them a solar system with possible or probable planets analogous to our own, he sees such multitudinous duplications of the physical conditions that have made life possible on our earth, that it appears to him incredible that all stand empty and lifeless.

The biologist, on the other hand, has at the forefront of his mind the history and evolution of life on the earth. He knows that although these conditions favoring the creation of living matter have existed on earth for many millions or hundreds of millions of years, yet life has not come into existence on earth save once, or at most half a dozen times, during that time. The living beings on earth are reducible at most to a few and probably to one primary stock, all their present variety being the result of the evolutionary processes of differentiation and adaptation. It must appear therefore to him that the real conditions for the creation of life on earth have involved, not merely the favoring physical conditions, but some immensely complex concatenation of circumstances so rare that even

on earth it has occurred probably but once during the æons of geologic time. The marvelous complexity of the fundamental substance of life, so complex even in its simplest forms that his most precise and elaborate methods of analysis give him but a partial and tentative comprehension of its real structure, must needs strengthen his concept of the immense complexity of the conditions necessary to its creation and evolution. If these conditions have not been duplicated on earth during the whole of the recorded history of life from the Cambrian down to the present day, it appears to him infinitely less probable that they have been duplicated elsewhere than on the earth.

That the "man in the street" should be sympathetic with the astronomer's rather than the biologist's conclusion is natural enough. The physical probabilities are obvious enough to all; the complexity of life and its conditions he does not realize; nor does he sense the minute relative proportion of time during which intelligent life has existed upon earth, or the vast and impassable barriers of space that preclude the transfer of organized matter from star to star. Moreover, to admit the probability of extra-mundane life opens the way for all sorts of fascinating speculation in which a man of imaginative temperament may revel free from the checks and barriers of earthly realities.

Such life, if it exists, would surely be evolved *ab initio* on independent lines of adaptation and the probabilities would be overwhelming that the results of the æons of its evolution, if by some rare chance it developed intelligent life simultaneously with its appearance on the earth, would be a physical and intellectual type so different fundamentally from our own as to be altogether incomprehensible to us even if we recognized it as being intelligence or life at all. Who that has studied the ant or the bee has failed to be impressed with the unplumbed mysteries in its sensations, its psychology, its inner life! We are far from any full understanding of the intelligence, if I may use the word, of the social insects, relatives, albeit distant relatives, of our own, brought up under the identical environment of terrestrial conditions. How much farther would we be from any comprehension of the intellectual processes of a race of beings whose ultimate origin was wholly different from ours, whose evolution was shaped under conditions that, however closely parallel, could not have been identical with those of the earth. Indeed, if we are to take a receptive attitude in this matter, why limit ourselves to protoplasm as the basis of life? What reason have we to suppose that a self-perpetuating substance, capable of acquiring the heterogeneity of function, the multiple complexity of structural adaptation, the specialization of parts, the elaboration of control and correlation organs, and finally the dominance of these last and development of conscious and intelligent beings, must necessarily be based upon the semi-liquid jelly upon which life, as we know it, is fundamentally based? Other substances, solid, liquid, or even gaseous, may have similar capacities, may have carried them out under different conditioning laws, to a result equally complex and marvelous. We know of nothing of the sort. But would we know of it if it existed, even if it existed upon earth? Would there be any conceivable method of communication, any common ideas, interests, or activities, between such beings and ourselves? It does not appear probable. How much less the probability of communication across the void of interplanetary space.

To suppose that parallel evolution could go so far as to produce similar methods of exploiting the earth to those used by civilized man—irrigation canals, cities, or other such phenomena of the immediate present—in life evolved independently in different planets—and to produce them at an identical moment in geologic time—would seem to be the result of those limitations of constructive or creative thought which are characteristic of myth and fairy-tale, of the anthropomorphic god, or the animal that thinks and talks like a man. Civilized men cannot form any real concept of intelligent life on Mars save in terms of civilized life on earth. Yet, so far as we may judge

from earth conditions, if life exists at all on Mars, it is a thousand to one that it is not intelligent life, for intelligent life on earth is a phenomenon that has existed for about a thousandth part of the geologic record of life. And it is a hundred thousand to one that it is not civilized life, for civilized life has existed at the utmost for a hundredth part of the time that man as such has been on the earth. Could we view the earth from without at any earlier portion of her history, we would by no means conclude that the existence of life must needs involve or culminate in the existence of intelligent life, still less of civilization. We have no means of knowing whether its existence at the present moment is a transitory episode or the commencement of a new era. But if it be the latter, it is probable that the external evidences of civilization a hundred centuries in the future would be as incomprehensible to us to-day, as impossible to interpret in the light of our present knowledge and customs, as our modern civilization would be to the pithecanthropos or the chimpanzee. Does any one seriously suppose, after considering the trends and progress of the last few centuries, that our descendants a thousand centuries hence will still be growing grain and irrigating fields for human provender? Such primitive expedients in food production will probably be obsolete in a hundredth part of that time. Life on earth at any other moment than the immediate present would not be indicated to an outsider by any such evidence as our present civilization might afford. Nor is it in the least probable that life upon another planet would be indicated by such evidence at any stage of its existence, or would have any resemblance to our own sufficient for us to recognize it.

In sum it appears to me as a paleontologist that

1. The complex concatenation of circumstances necessary to bring about the initiation of life has occurred upon earth half a dozen times at most, probably but once, in an environment that has apparently been favorable for a thousand million years. The probability of its occurring in a substantially similar environment upon another planet is so slight as to be practically reducible to a mathematical zero in any particular instance.

2. The number of solar systems being almost infinite, we might regard the number of such possible favorable environments as amounting practically to infinity.

3. The resultant of these two considerations is that there is a finite and reasonable chance that life has existed or will exist somewhere else in the universe than on this earth alone.

4. The probability that intelligent life exists is vastly less, and that anything in the least analogous to our civilization exists at the present time is so slight as to be negligible.

5. If any life involving the development of self-consciousness, of abstract thought and introspection analogous to the higher intelligence of mankind, or the control of environment and utilization of natural resources that we call civilization, should develop independently upon some other planet out of the preexisting simpler phases of life, it probably—almost surely—would be so remote in its fundamental character and its external manifestations from our own, that we could not interpret or comprehend the external indications of its existence, nor even probably observe or recognize them.

6. In any specific instance, such as other planets of our own system, the probabilities of the existence of any kind of life amount to practically zero. The probabilities of an intelligent life upon Mars or Venus or elsewhere in our system so similar to our own in its character and manifestations as to be indicated by irrigation canals, cities, or other manifestations of human civilization, appears to be zero of the second degree. The most that one can allow as a reasonable possibility is that there may be some form of life existing somewhere else in the universe than upon our planet. That we have or shall ever get evidence of its existence appears to me practically impossible in the light of present knowledge and limitations.

W. D. Matthew
The American Museum of Natural History

GEORGE TRUMBULL LADD

George Trumbull Ladd, for forty years professor of moral philosophy and metaphysics at Yale University, died on August 8, at the age of eighty-one years.

In the eighties and nineties, Ladd was a towering figure, through his academic leadership, in the introduction of the new psychology. This was the period in which physiological, experimental, genetic and abnormal psychology gained recognition in the college curriculum of this country, and Ladd did much to bring this recognition. Yet, he was not primarily a psychologist and did no experimental work in any of the fields which he so ably introduced. He came into psychology through philosophy, and had come into philosophy through theology. History will probably recognize him as an organizer rather than an inspirer, or an original contributor in specific problems.

While always regarded as more or less dry, his books and lectures were characterized by remarkable clearness, accuracy, thoroughness, broadmindedness and chasteness of style and a pleasing absence of the irrelevant. His definitions were those of a logician; his scientific perspective was that of a philosopher; his power of appeal was that of the forceful teacher. The fidelity and constructive analysis with which he interpreted the findings of research men in physiology, physics, medicine and genetics gave dignity and permanence to his work. The encyclopedic character of his work shows him at his best in his power to organize for himself and put in teachable form these new and diverse approaches to the study of the human mind. His "Elements of Physiological Psychology" and "Psychology Descriptive and Explanatory" will live as classics from that period.

His conservatism was another feature which gave his work in that period prestige and success. Wundt, Ribot, Galton, James, Hall, Cattell, Baldwin, Scripture, and others, each came out with a different brand of psychology which was bound to draw out some temporary antagonism; but Ladd welcomed all these and quieted the turbulent waters by certifying and formulating as a philosopher, as a preacher and as a teacher what was "wholesome" and giving it a setting in academic psychology. As an original thinker, Ladd's power lay not in the scientist's observation and discovery within a narrow field, but rather in the power of a great thinker to interpret and organize new and relevant facts.

His utterances on mental evolution, on mental measurement, on disorders of personality, on "psychology without a soul," make most interesting reading from the present point of view. The new points of view are all in his work, but their presentation is so sagaciously qualified as to make the present reader question whether he had actually recognized the real significance of these new concepts in psychology. Yet, it was this mode of conservative thought and guarded statement that gave stability to his teaching and made it for many years the orthodox point of view in the new psychology. He made the transition not only from philosophy to psychology but also from theology to psychology and from common sense view of daily life to scientific psychology without any break or antagonism.

Ladd's influence in psychology was cut short by an unfortunate breaking up of the department in the late nineties, which led to his premature retirement and deprived him of the contact with the younger working constituency and the opportunity of projecting himself through such a constituency. His interest then turned to interpretative psychology through his various books on psychology as applied to philosophy, ethics, æsthetics, social life, and religion. His appeal was here to the general reader, and in this field his utterances are characterized by the same traits that we found in the earlier academic period.

C. E. Seashore

The National Research Council,
Washington, D. C.,
August 20, 1921

SCIENTIFIC EVENTS

THE BRITISH IMPERIAL BUREAU OF MYCOLOGY

In 1918 the British Imperial War Conference had brought to its notice the loss to

the empire caused by fungoid diseases of plants.

A Canadian estimate places the loss in the year 1917, in the prairie region of Canada alone, at 100,000,000 bushels, worth from £25,000,000 to £50,000,000. For the same year, the loss in the five chief cereals of the United States due to this fungus was placed at 400,000,000 bushels. The annual loss on Indian wheat is estimated in millions of rupees.

A proposal was adopted for the establishment of a central organization to encourage and coordinate work throughout the Empire on fungi in relation to agriculture. The Colonial Office has brought the necessary negotations to a successful issue, and has now formed a mycological bureau supported by contributions from the various self-governing Dominions, India, Egypt, the Sudan, and the non-self-governing Colonies and Protectorates. The precedent of the Imperial Bureau of Entomology has been followed, and the new institution is to be managed by a committee of experts under the chairmanship of Lord Harcourt. The headquarters of the bureau are to be at Kew, and it is to work in close association with the Royal Botanic Gardens, where there are already a magnificent library, laboratories, and a department for fungi in the museum.

CERAMIC INVESTIGATIONS BY THE UNITED STATES BUREAU OF MINES

A NEW ceramic laboratory, in which investigative work regarding the clays of the Northwest will be conducted, is to be installed at the Northwest Experiment Station of the United States Bureau of Mines on the campus of the University of Washington at Seattle.

The laboratory work in connection with a general study of the clays of Washington has been completed, and a bulletin on the subject of Washington clays is now in course of preparation.

At the Northwest Experiment Station an attempt is being made to remove iron and silicon from kaolin to produce either sillimanite or the oxide of aluminum. Clay was melted in an arcing furnace in presence of carbon; some silicon and iron were volatilized and some reduced to metal. The products contained less iron oxide and silica and more alumina than previously, but not in sufficient amounts to be sillimanite. The refractoriness of these products is to be determined by the ordinary tests.

A cooperative agreement has been effected between the United States Bureau of Mines and the Central of Georgia Railway for an investigation by the Ceramic Experiment Station, Columbus, Ohio, of the white clay and bauxites through central Georgia along the railroad right-of-way. R. B. Gilmore, formerly ceramic chemist with the Vesuvius Crucible Co., Swissvale, Pa., and H. M. Kraner, formerly ceramic assistant of the Bureau of Mines, have been assigned to this work. Preliminary tests on the effects of low calcination temperatures on the colloidal content of Georgia white clays have been made. By calcining Georgia clay to from 500° to 600° C. the adsorptive properties were reduced to those of the English china clay, without materially reducing its plasticity.

A microscopic examination of the mineral constituent of kaolins is being conducted at the Ceramic Experiment Station at Columbus.

THE BIOLOGY CLUB OF THE OHIO STATE UNIVERSITY

DURING the academic year of 1920–21, the Biology Club of the Ohio State University held monthly meetings from October to May, inclusive. The club, organized in 1891, is one of the oldest organizations of the university. It is composed of members of the science faculties, graduate students, and those interested in scientific research. Opportunity has been given the past year for discussions of scientific experimentation and investigation by members of the faculties, and reports of research by graduate students. The following papers were presented:

Oct. 11. Reports on a survey of Ohio fishes.
1. "Distribution of Ohio fishes," Professor R. C. Osburn.
2. "Food of the large mouth bass," E. L. Wickliff.
3. "Algal food of the gizzard shad," L. H. Tiffany.

Nov. 2. "The Hessian fly in Ohio," Professor T. H. Parks.

Dec. 6. "Some new factor relations in barley," Professor J. B. Park.
"Effect of environment on expression of characters in hybrid oats," D. M. Lutz.
Jan. 10. "The vegetation of the Lake Okoboji (Iowa) region" (lantern slides), Professor A. E. Waller.
Feb. 14. "The inferior vena cava of man and mammals—its abnormalities and their interpretation from the standpoint of their development," Professor C. F. McClure, Princeton University. (Joint meeting with the Omega Chapter of the Society of the Sigma Xi.)
Mar. 7. "The origin and development of the prairie," Professor H. C. Sampson.
Apr. 11. "Some measurements of emotional states," Professor H. E. Burtt.
"Parasites on aphids," E. A. Hartley.
May 2. "Some recent applications of physics to biological problems," Professor Alphaeus W. Smith.
"Experimental work with mealy bugs," W. S. Hough.

The president of the club for the year was Dr. C. H. Kennedy, of the department of zoology and entomology; the vice-president, Dr. J. W. Bridges, of the department of psychology, and the secretary, Dr. L. H. Tiffany, of the department of botany.

DR. CARL L. ALSBERG AND THE BUREAU OF CHEMISTRY

In formally accepting the resignation of Dr. Carl L. Alsberg as Chief of the Bureau of Chemistry, Secretary Wallace wrote him as follows:

Permit me, in formally accepting your resignation, once more to express my sincere regret that the government and this department will no longer have the benefit of your services.

Your nine years in the department have been fruitful years. You have attained a leadership in scientific work not alone in this department, but in the larger field seldom reached by men of your years. The tender of the important position which you have accepted is evidence of this.

Your administration of the food and drugs act has been characterized by tactfulness, fearlessness, justice, and common sense, and you have, therefore, commanded the confidence and respect both of those who have come under the law and of the great public whose health you have so zealously protected. Your work in this field has been an inspiration which I hope will continue with us.

It is not often that one attains such outstanding eminence in both research and administrative work.

We shall all miss you here; especially I shall miss your wise and sane counsel from which I have profited very much in the rather trying task of undertaking to qualify for a difficult and important work. I wish that you might still be within call.

Notwithstanding our regret that you are leaving the department, all of us here rejoice in the opportunity that has opened for you to pursue important research in a field in which you have such a great heart interest. We are expecting much of you; we are confident that you will make large and valuable contributions to the national welfare.

I know that I express the feelings of every one in this department when I say that our very best wishes go with you, and if at times you find that we can be of help in the work you are now undertaking, we shall expect you to call upon us with full assurance of a prompt and sympathetic response.

SCIENTIFIC NOTES AND NEWS

The American Chemical Society held last week its sixty-second meeting at Columbia University, New York City, under the presidency of Dr. Edgar Fahs Smith, provost emeritus of the University of Pennsylvania. The principal events of the program have already been recorded in Science and we hope to print in subsequent numbers accounts of the business transacted and abstracts of the papers before the sections.

The Second International Eugenics Congress meets at the American Museum of History, New York City, next week under the presidency of Dr. Henry Fairfield Osborn, with Dr. Alexander Graham Bell as honorary president. The opening meeting will be held in the Hall of the Age of Man on September 22, when addresses will be made by Dr. Osborn, Dr. Charles B. Davenport and Major Leonard Darwin.

At the meeting of the British Association for the Advancement of Science, held at Edinburgh from September 7 to 14, a joint discussion before the sections of mathematical and physical science and of chemistry on "The structure of molecules" was opened by Dr. Irving Langmuir, of the research laboratory of the General Electric Company. Others taking part in the discussion were Profes-

sor A. Smithells, Professor W. L. Bragg, Professor J. R. Partington, Professor A. O. Rankine, and Dr. S. H. C. Briggs.

THE quinquennial prize for the best work in the medical sciences, offered by the Brussels Academy of Medicine, has been awarded to Professor A. Brachet of the chair of anatomy and embryology of the University of Brussels.

FROM exchanges we learn that the University of Vienna has created an honorary title to express its gratitude to those who have aided in relieving the material distress of the university during the last few years. The honorary title has been conferred on Dr. Ferrière, the president of the International Red Cross, and Dr. Franz Boas of Columbia University besides the ambassadors of Great Britain and Sweden, Mr. Herbert Hoover, the president and ambassador of Argentina and an English woman, Lady Mary Murray.

MR. J. P. BONARDI, who has been with the Bureau of Mines Experiment Station at Denver for the past five years, has accepted a position as manager of the assay and chemical department of the Mines and Smelter Supply Co., of Denver, Colo.

MAJOR GENERAL W. L. SIBERT, head of the Chemical Warfare Service during the war, is now on his farm in Warren County, Kentucky, where some twenty oil wells are being developed.

MR. CHARLES K. WEAD, for over twenty years an examiner in the U. S. Patent Office in the Class of Music, has resigned and gone to Ann Arbor, Mich, to live.

PROFESSOR EDWARD A. WHITE, of Cornell University, has sailed for England to spend several months in study at the Royal Botanic Gardens at Kew; he will also study commercial floriculture in other parts of England and Scotland, and in Holland and Belgium.

THE advisory committee provided for by the Importation of Plumage (Prohibition) Act recently enacted by the British Parliament has been constituted as follows: Lord Crewe (chairman), Mr. E. C. Stuart Baker and Dr. W. Eagle Clarke (representing ornithology), Mr. C. F. Downham, Mr. W. G. Dunstall, and Mr. L. Joseph (representing the feather trade), Lord Buxton, Capt. E. G. Fairholme, Mrs. Reginald McKenna, and Mr. H. J. Massingham.

A MEMORIAL tablet was recently placed on the house at Enghien-les-Bains, formerly occupied by the radiologist, A. Leray, who succumbed last spring to the effects of roentgen-ray injury acquired during his work for the wounded during the war.

WE learn from *Nature* that on July 21, a memorial was unveiled in the public gardens at Dartmouth to the memory of Thomas Newcomen, the pioneer of the steam engine. Newcomen was born in Dartmouth in 1663; he followed the trade of blacksmith there, and was also a Baptist preacher.

THE Royal Photographic Society is collecting funds for a memorial at Lacock to W. H. Fox Talbot, distinguished for his work in scientific photography.

Nature announces the death, at the age of eighty-nine years, of Samuel Alfred Varley, known for his work on the applications of electricity.

JULES CARPENTIER, known for his work on the designing and manufacture of electrical and scientific apparatus, member of the Paris Academy of Sciences, has died at the age of seventy years.

PROFESSOR OSWALD SCHMIEDEBERG, formerly professor of experimental pharmacology in Strasbourg, died in Baden-Baden on July 12, at the age of 82.

PROFESSOR N. A. CHOLODKOVSKY, author of works on entomology and helminthology, professor emeritus in the Academy of Medicine and at the Institute of Forestry, has died in Petrograd at sixty-one years of age. Professor Cholodkovsky was also a distinguished poet.

A REUTERS dispatch from Christiania dated August 13 states that a telegram to the *Aftenpost* from Hammerfest says that the expedition sent to Siberia to search for Tessem and Knudsen, the missing members of the Amundsen expedition, failed to find any trace of the

men at Cape Wild, where they were supposed to be. Two members of the relief expedition will continue the search in Northwest Siberia.

The Lange Koch expedition which left Denmark last year and wintered in Melville Bay started for Peary Land on March 15. There has been some difficulty in the transport across Melville Bay as the Cape York Eskimos hired for this task had not arrived, but it is hoped that everything was got across safely.

Dr. J. Charcot, the French polar explorer, sailing in the North Atlantic in his exploring vessel, the *Pourquoi Pas,* has succeeded in landing upon the islet of Rockall, which lies some 260 miles west of the Hebrides and 185 miles from St. Kilda.

The Antarctic expedition by Sir Ernest Shackleton planned to leave England on September 12. The steamer *Quest* was found to give inadequate accommodations for the increased personnel necessary after the program to be followed was increased, and alterations made on the ship delayed the work of fitting out the expedition.

The British Iron and Steel Institute met in Paris under the presidency of Dr. J. E. Stead on September 5 and 6.

The *Scientific American,* long the leading weekly American journal of industry, invention and science, will hereafter be published monthly in combination with *The American Scientific Monthly.*

Several hundred American engineers will meet with representatives of the principal engineering societies of Great Britain and France at a dinner to be given at the Engineers' Club in New York City on the evening of October 10. The dinner, while formally celebrating the homecoming of the mission of American engineers who went abroad to confer the John Fritz Medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris, will mark the launching of a new movement to bring English and American engineers together. The guests at the dinner will include the twelve members of the deputation which represented the John Fritz Medal Board and representatives of the British and French societies by which they were received. Invitations have been extended to many men prominent in public life, including Mr. Herbert Hoover, Secretary of Commerce; Viscount Bryce and Mr. Charles E. Hughes, Secretary of State. Others who will attend are the governing boards of the four national engineering societies, the John Fritz Medal Board of Award, the Library Board of the Engineering Societies and of the Engineers Club; the trustees of the United Engineering Society, and the officers of the Federated American Engineering Societies.

The *Journal* of the American Medical Association states that according to an agreement to improve their equipment and coordinate their personnel, the several public health agencies operating laboratories in Memphis on September 1 moved into their new quarters in the university laboratory. Dr. William Krauss, professor of preventive medicine and hygiene in the college of medicine for many years, has been made director of the laboratories, and his salary will be paid jointly by the agencies interested, which include the malarial research laboratory of the U. S. Public Health Service, the West Tennessee laboratory of the State Board of Health, the department of bacteriology of the University of Tennessee College of Medicine, and the laboratories of the Memphis department of health. The plan of coordination has received the endorsement of Dr. Frederick F. Russell, director of laboratories for the International Health Board.

Under the auspices of the Yale Medical School, the state of Connecticut and the Rockefeller Foundation will unite to finance the proposed Connecticut Psychopathic Hospital. The Rockefeller Foundation will provide $500,000, the state probably the same amount, while the share and part of Yale in the transaction is not determined. The hospital building will be erected by the state grant, the Rockefeller Foundation will supply the salaries for the teaching staff, while Yale may

supply the clinical quarters and other costs. As the New Haven General Hospital is now a part of the Yale Medical School, the Psychopathic Hospital is expected to supply the cases under observation. There will be a close connection between the new psychopathic hospital and the New Haven General Hospital. Details of arranging for the gift will come before the Yale Corporation at its next meeting. Governor Lake of Connecticut recently appointed a commission to take charge of the plans for expenditure of the state fund of $500,000 for the hospital. Dr. Paul Waterman, of Hartford, is chairman of the commission, and Dean Winternitz, of the Yale Medical School, is a member.

Nature says: "The classical experimental plots which Lawes and Gilbert started at Rothamsted have been of the greatest service to agricultural science, and their importance is constantly increasing. Fundamental questions in the physics, chemistry, and biology of agriculture can be attacked with more confidence in the light of results obtained from long-continued field experiments carried out on a systematic plan. Further, the results are capable of statistical examination. The importance of the Rothamsted experiments led to the institution of a parallel series at Woburn in 1876 by the Royal Agricultural Society. The Woburn soil is light and sandy, but that at Rothamsted is a heavy loam. The two series of experiments enable instructive comparisons to be made between these two soil types. All interested in agricultural science received with concern the decision of the council of the Royal Agricultural Society to relinquish—owing to economic conditions—the Woburn experiments. Fortunately the danger has been averted. Arrangements have been made for the experiments to be continued under the auspices of, but legally distinct from, the Rothamsted Experimental Station. The general portion of the Woburn farm will continue under the direct control of Dr. A. J. Voelcker, who for many years has carried out the duties on behalf of the Royal Agricultural Society. The new arrangement will not only ensure the continuance of the valuable work already done, but will also lead to a closer contact with the work of Rothamsted."

THE Directoria de Meteorologia e Astronomia of the Brazilian Department of Agriculture has been divided into two separate services "Directoria de Meteorologia 2" and "Observatorio Nacional." The division for meteorology has been placed under the direction of Dr. Sampaio Ferraz. It will continue the climatological work established in 1909, unifying methods of meteorological research and publishing all available data for the past ten years. It is planned to issue nine bulletins by the end of the year. The division will establish a forecast service for central and southern Brazil; an aerological service for aviators and kite and pilot balloon stations; a special coast service for navigation; an agricultural meteorological service; a marine meteorological service; a special service of rains and floods, and the usual investigations in every department of meteorology with especial reference to longer ranges in weather forecasting. Rio Grande do Sul, Minas Geraes and São Paulo continue their state services, but under the supervision of the Directoria. The Reclamation Service of semi-arid northeastern Brazil will maintain its rain organization.

STATISTICS relating to the growth of the population of France show that last year the excess of births over deaths was 159,790, as against 58,914 in 1913, while the number of marriages has doubled. It is the first time since the war that statistics have been available for the whole of France, including the three departments of Alsace-Lorraine. The births were 834,411 last year, compared with 790,355 in 1913—an increase of 44,056. The deaths were 674,621 against 731,441 in 1913—a decrease of 56,820. The marriages were 623,869 last year against 312,036 in 1913.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of the late John McMullen, president of the Atlantic, Gulf and Pacific Dredging Company, Cornell University will

receive a bequest estimated at from one to two million dollars.

Fire which resulted in damage to equipment of approximately $20,000 and to the building of about $28,000 was discovered in the attic of the Richardson Chemistry Building, Tulane University, New Orleans, on the morning of July 6.

Dr. J. M. Bell succeeds Dr. F. P. Venable as head of the department of chemistry at the University of North Carolina. Dr. Venable, who was formerly president of the university, has resigned as head of the chemistry department, but retains his professorship.

Dr. Eugene P. Deatrick has resigned as instructor of soil technology, College of Agriculture, Ithaca, N. Y., to become associate professor of soils, and head of department, West Virginia University, Morgantown, W. Va.

Dr. Reuben S. Tour has been appointed professor of chemical engineering at the University of Cincinnati. Dr. Tour, who succeeds Dr. O. R. Sweeney, who resigned because of ill health, has served for several years as an expert for the government on nitrate and other chemicals, and will continue to act as consulting expert for the government.

Dr. Chas. C. Macklin has resigned his position as associate professor of anatomy in Johns Hopkins University to accept the professorship of histology and embryology in Western University, London, Canada.

Professor H. Lebesque, of the faculty of sciences, University of Paris, has been elected professor of mathematics at the Collège de France.

DISCUSSION AND CORRESPONDENCE

SECULAR PERTURBATIONS OF THE INNER PLANETS

To the Editor of Science: It is true, as Professor Poor states (Science, Vol. 54, pp. 30–34, 1921), that if we are at liberty to assume any distribution of density we like around the sun it is not difficult to account for all the secular perturbations of the four inner planets within their mean square errors, by means of the Newtonian law of gravitation. Professor Poor, however, does not appear to have read much of the paper of mine to which he refers,[1] or he would have noticed that the density we are at liberty to assume is subject to very severe limitations. It is possible to estimate the density of the matter at any distance from the sun directly; for the amount of light it scatters is known from observations of the zodiacal light and the corona, and by considering different possible constituents, whose scattering powers for given masses are known, we can determine limits to the density. Seeliger and de Sitter succeeded in explaining the residual secular perturbations of the four inner planets by means of two ellipsoids of matter, one close to the sun, and the other extending to the orbit of the earth. I showed, however, in the paper referred to, that the density of the matter between the orbits of Mercury and Mars can not exceed 1/600 of that required by these writers, and in a later paper[2] I showed that the disturbing effect of the matter near the sun can not exceed 10^{-9} of that supposed to be produced by their inner ellipsoid. Accordingly, none of the secular perturbations of the inner planets can be explained by means of the Newtonian law of gravitation. The fact that the excess motion of the perihelion of Mercury is accounted for by Einstein's law therefore decides definitely in favor of the latter. Further, Einstein's law is the simplest that can account for it. None of the other nine residuals exceeds 3 times the corresponding mean error, and only three of them the mean error itself, and there is therefore no reason to regard them as anything but accidental errors.

Harold Jeffreys

St. John's College,
Cambridge, England

1 "The Secular Accelerations of the Four Inner Planets," *Monthly Notices*, R. A. S., Vol. 77, pp. 112–118, 1917.

2 "On the Crucial Tests of Einstein's Theory of Gravitation," *loc. cit.*, Vol. 80, pp. 138–154, 1919.

SPOROZOAN INFECTION

TO THE EDITOR OF SCIENCE: I have just detected, in an American recently arrived in the Philippine Islands from the United States, a case of infection with *Isospora hominis* Rivolta, 1878 (emend Dobell, 1919). Circumstances connected with the case lead me strongly to suspect that the infection was contracted in the United States. Inspection of the recent literature has disclosed that since 1918, at least eleven cases of sporozoan infection (including *Isospora*) have been discovered in the United States. Four of these cases apparently are autochthonous. They will be found in the tables accompaning papers by Kofoid and his coworkers,[1, 2] on the examination of overseas and home service troops in New York. These findings have escaped comment for one reason or another and, as the patient studied by me has never been in any part of Europe—much less the Eastern Mediterranean area where coccidial infections seem to be endemic, I consider we have reason to suspect that dissemination of the parasite is occurring among the civilian population of the United States.

We have little knowledge of the clinical manifestations of "human coccidiosis" and no knowledge of its pathology. Reports indicate that the parasite is not especially harmful to adults, but too much should not be assumed in this direction. Especially should we be watchful for infections in children and in people of lowered vitality. The cysts of the coccidia are highly resistant to desiccation, and to the action of chemicals and disinfectants, and they remain viable for long periods of time—much longer than do the cysts of other intestinal protozoa infesting man, so that the parasite presents a difficult problem in epidemiology.

All available information should be gathered at this time, regarding the incidence of human coccidiosis in the United States, for it may be possible to trace the cases originating in the soldiers already observed, and other cases that it is not unlikely have originated from them by this time. Such studies can not begin too early. With the object of aiding such an investigation, I am, by authority of Professor Elmer D. Merrill, director of the Bureau of Science, sending preserved material from our case to the following specialists, where it will be available for comparison with any material that may be found in the United States:

Professors Gary N. Calkins, Columbia University, New York; Robert W. Hegner, Johns Hopkins University, Baltimore, Md.; Henry B. Ward, University of Illinois, Urbana, Ill.; Charles A. Kofoid, University of California, Berkeley, Calif.; R. B. Gibson, Iowa State University, Iowa City, Ia.; Ernest E. Tyzzer, Harvard University Medical School, Boston, Mass.; Kenneth M. Lynch, Medical College of the State of South Carolina, Charleston, S. C.; James C. Todd, University of Colorado, Boulder, Colo.; Mark F. Boyd, University of Texas, Galveston, Tex.; and Allen J. Smith, University of Pennsylvania.

FRANK G. HAUGHWOUT

BUREAU OF SCIENCE,
MANILA, P. I.

[1] Kofoid, Kornhauser and Plate, *Jour. Amer. Med. Assoc.*, Vol. 72, p. 1721, 1919.

[2] Kofoid and Swezy, *N. O. Med. and Surg. Jour.*, Vol. 73, pp. 4–11, 1920.

SCIENTIFIC LITERATURE AND APPARATUS FOR ROUMANIA

TO THE EDITOR OF SCIENCE: You were so kind as to publish in SCIENCE (April 8) my letter in which I showed: (1) That our Institutions do not possess American books and instruments; (2) that the disadvantageous exchange of our money since the war, prevents us from making scientific purchases in the United States; (3) that means should be found to remove a difficulty that hinders scientific relations.

This letter provoked the interest of the American universities and intellectuals. I received not only approvals but also gifts consisting of books and even scientific instruments.

We accept with gratitude all these manifestations of sympathy, but they do not

bring the practical solution of our question.

The institutes of our university have funds that would be sufficient if the value of the dollar were of 5 lei, as it was before the war, and not 90–100 lei as it is now. The credits assigned to our laboratories, even augmented, can not meet at the same time the general rise in price of scientific materials and the disadvantageous exchange of our money.

The solution of this great difficulty might be found, I think, in the organization of a credit with a fixed term of payment in 3 or 4 years. Such credits were organized during the war for the supply of engines of destruction; why should it be impossible to organize them in a time of peace in order to facilitate scientific cooperation and for the benefits of science?

I think that this organization might be created. Under the auspices of an American scientific association a number of booksellers and instrument makers might be grouped, forming a society which would divide among them the orders of our institutions centralized by the chancellor of the university.

The total sum forming the price of the objects, guaranteed by the university, would be divided into two fractions: one part payable immediately and another credited for 3 or 4 years, with a fixed annual interest. Our universities are state institutions and offer every guaranty of solvency.

I beg again the friends of science and of international cooperation to be willing to examine the question also from this point of view and seek the solution of the organization of this credit. Our university is ready to make every sacrifice in its power in order to secure practically and permanently the cooperation of American science.

E. G. Racovitza

Institute of Speology,
University of Cluj,
Roumania

AMERICAN SCIENTIFIC LITERATURE FOR FOREIGN COUNTRIES

In Science, Volume 53, page 335, April 8, 1921, Professor Racovitza, of the University of Cluj, Roumania, points out that his university is practically barred from access to the American scientific literature and scientific instruments by the present state of foreign exchange. He points out that Science, which before the war cost thirty-five Roumanian lei, now costs five hundred and ninety-five lei.

The Biological Club of the University of Minnesota believe that such a situation should not exist and that American scientific literature should be widely disseminated in Europe. Obviously, however, the University of Cluj can not purchase many American journals at such a rate of exchange. Accordingly the secretary of the Biological Club was authorized to write Professor Racovitza and ask him for a list of journals which he would prefer to have in their library. In a letter under date of July 16, he submits the following list in order of his preference: (1) *The American Naturalist,* (2) *Ecology,* (3) *Genetics,* (4) *Journal of General Physiology* (Loeb), (5) *Journal of Morphology,* and (6) *Journal of Experimental Zoology.*

The Biological Club is accordingly asking the publishers of *The American Naturalist* to send that journal to the library of the Institutul De Speologie, Universitatea Din Cluj, and bill the subscription price to the Club until further orders.

We are publishing this note in Science in the hope that similar scientific organizations will take like action. In case such action is taken by any organization it is suggested that it might be advisable in order to avoid sending duplicate journals to their library that a central clearing house of some sort should be established. If this seems best the undersigned would be glad to serve in this way.

H. D. Barker,
Secretary of the Biological Club

THE TRUTH ABOUT VIVISECTION

To the Editor of Science: In the *Womans Home Companion* for July, 1921, is the best paper on this subject I have ever seen called "The Truth about Vivisection" by Mr. Ernest Harold Baynes. Mr. Baynes first read

the literature on both sides and then visited practically all the laboratories from the Mayos' at Rochester, Minnesota, to the eastern seaboard. He visited especially the Rockefeller Institute several times, also a number of European laboratories. He became thoroughly convinced (1) that the experiments were not cruel, (2) that the statements in the literature of the antivivisectionists were often garbled and utterly misleading, and (3) that the results to animals themselves as well as to human beings were of enormous benefit. Then he wrote the article, and Miss Lane, the editor of the *Companion,* bravely printed it.

The especial significance of *his* writing such an article lies in his nation-wide reputation as a lover of animals and their protector. He is the father of all the bird-refuges in the United States. His lectures on animals have been heard everywhere, and when *he* approves of experiments on animals every one knows that he has good reasons for so doing.

The fury of the antivivisectionists at once rose to fever heat. The New York Antivivisection Society through its president, Mrs. Belais, sent out an extraordinary appeal calling him "one Ernest Harold Baynes"—almost as if one should write "one Herbert Hoover"! In a paragraph all in capitals Mrs. Belais called on all lovers of animals to help crush Miss Lane financially not only by cancelling their own subscriptions but by urging all their friends to do the same—a nationwide boycott. This extraordinary method will ensure a reaction in favor of Miss Lane because of its vindictive unfairness. It is not argument, it is persecution and is also illegal.

It behooves the friend of scientific research and *real* lovers of animals to support Miss Lane by expressing to her by mail their admiration of her courage, and by adding their own names to the list of her subscribers. Her address is 381 4th Ave., New York, and the cost of a year's subscription is only two dollars. She has received hundreds of letters from the A-Vs—many abusive. The November and succeeding issues will contain some interesting reading.

Mr. Baynes has also been attacked by mail and by cancellation of engagements. It is up to us to sustain so doughty a champion. He has given the antivivisectionists the hardest blow I have known in 40 years.

W. W. Keen

QUOTATIONS

CHEMISTRY AND THE PUBLIC

It is fitting that 3,000 British, Canadian, and American chemists should be sitting together at Columbia University, for they have been acting together for seven years. The chief feature of American chemical history after 1914 was the remarkable cooperation of American and Allied—especially British—chemists upon problems pertaining to munitions and other war essentials. They found themselves faced by a Germany which had built up its chemical industries by decades of shrewd effort. As Mr. Garvan said on Wednesday, the Germans had taken the discoveries of the British chemist Perkin—the Perkin Medal is one of our most prized scientific awards—and had made it the basis for a chemical technology unapproached elsewhere. Happily, we were able to build up some branches of industrial, agricultural, and electrical chemistry with a speed that surprised those who were unacquainted with our resourcefulness and our skill in research. By the end of 1915 the United States had the largest aniline plant in the world and was credited with nitric acid and nitro-cellulose plants three times greater than any others.

Not since Syracuse waited for the inventions of Archimedes to beat off the Romans has attention been concentrated upon science in war-time as Americans concentrated it upon chemistry after 1917. We had been shocked into a realization that we had depended upon Germany for medicines and dyes; that we had developed no independent potash resources; that we had done little with our Louisana sulphur; that we had looked to Chile for nitrates which we should have manufactured in part for ourselves, and that we had wasted the precious by-products we might

have gained from coking. The results of our awakening are shown in the newly issued summary of the 1920 census. In 1914 the United States had 754 establishments manufacturing chemicals, with products worth $200,195,800. In 1920 it had 1,374 establishments, with products worth $694,643,000. The increase in the value of the products in six years was 247 per cent. The manufacture of potash and potassium products was slightly more than twice as great—measured in value—as in 1914; that of acids about two and a half times as great; that of sodas and sodium almost three times as great, and that of coal tar products was $133,340,000, as against $8,839,000 in 1914, or about fifteen times as great.

Gratifying as this progress is, the complexity of some essential chemical industries, the careful adjustments they must establish with other industries, render more progress necessary before we are safe. Leaders in the coal-tar business, which are vital to national defence, declare that although we have far surpassed all other nations except Germany and Switzerland, we need five years yet to make our position impregnable. For the time being many of our drug-making and dye-making firms—we had 213 companies making these and other coal-tar products last year—have a right to complete tariff protection. The chemists at Columbia University have adopted resolutions asking for a "selective embargo." Any embargo needed in certain parts of this field can and should be provided by wise tariff legislation, and not, as some demand, by the arbitrary decrees of a licensing bureau.—*New York Evening Post.*

SPECIAL ARTICLES

TRIPLOID INTERSEXES IN DROSOPHILA MELANOGASTER [1]

In an experiment made to determine the locus of the new second-chromosome recessive mutant "brown" by means of a back-cross with the well-known second-chromosome recessives plexus and speck, one culture was found that produced a total of 96 females, 9 males, and about 80 individuals that were intermediates between males and females.

The "intersexes," which were easily distinguished from males and from females, were large-bodied, coarse-bristled flies with large roughish eyes and scolloped wing-margins. Sex-combs (a male character) were present on the tarsi of the fore-legs. The abdomen was intermediate between male and female in most characteristics. The external genitalia were preponderantly female. The gonads were typically rudimentary ovaries; and spermathecæ were present. Not infrequently one gonad was an ovary and the other a testis; or the same gonad might be mainly ovary with a testis budding from its side. The intersexes showed considerable variation, apparently forming a bimodal group—on the one hand a more "female-type," the extreme individuals of which might even lack sex-combs, and, on the other hand, a more "male-type," many of the individuals having large testes and normal male genitalia. All intersexes proved sterile.

Just as striking as the production of intersexes was the fact that the 96 females and 9 males of that same culture showed three, instead of two, large classes representing original combinations, namely, plexus speck, plexus brown, and brown speck. Extensive tests were made of these flies; and each was found to have received from the father a second-chromosome carrying plexus brown and speck, and to have received from the mother one of three different second-chromosomes, namely, a plexus brown, or a plexus speck, or a brown speck chromosome. That is, the mother of the intersexes had carried *three* second-chromosomes, instead of two. For each of the loci plexus, brown and speck she had carried two recessive genes for the mutant character and one wild-type allelomorph, with nearly complete dominance of the wild-type gene in each case.

A condition of triploidy for certain sections of chromosome had been met with in the previous (unpublished) studies on duplications and on translocation; but that this triploidy was far more extensive soon became evident.

[1] Paper read before the Pacific Division A. A. A. S., Univ. of Cal., Aug. 5, 1921.

The third-chromosome recessive "white-ocelli" had been present in the original culture; and tests of the flies produced by that culture showed that white-ocelli was being distributed in the same abnormal fashion as were plexus brown and speck. Not only were the second- and third-chromosomes involved, but the X-chromosome as well, as was shown by specific tests with sex-linked characters.

The hypothesis that the intersexes were triploid was easily put to test by direct cytological examination. The chromosomes (which were unusually clear and well separated) consisted of two sets of three V's (the two sets differing in the size of the V's), a pair of rods, three or two small round chromosomes, and a J-shaped chromosome or not. That is, all intersexes possessed the second- and the third-chromosomes in triplicate and the X- in duplicate, but they might possess three or two fourth-chromosomes, and have or lack a Y-chromosome, so that four sub-types of intersex constitution were found.

About ten per cent. of the daughters from the original culture, when tested, produced in turn intersexes and further disturbances of the linkage ratios. These females were presumably triploid for all the chromosomes (except the fourth, which might be present in duplicate). It was then discovered that these intersex-producing females could be identified by their somatic characters, which were similar to, but less extreme than, those of the intersexes—namely, large size, coarse bristles, and large roughish eyes. Stocks producing triploids and intersexes were maintained more easily by taking advantage of the fact that triploid females carrying two white and one eosin gene have a pale yellow eye-color lighter than that of their diploid white-eosin sisters, and likewise that the third-chromosome dominant Delta is dominant over two recessive non-Delta genes, but the triploid heterozygote is markedly different from the diploid heterozygote.

With material from these stocks genetical proof was obtained that the intersex-producing females possess in triplicate the loci for a large variety of first-, second- and third-chromosome genes, and that they might possess fourth-chromosome loci in triplicate or in duplicate. This genetical finding, checked by cytological examination, extends the direct proof of the chromosome theory of heredity to specific second- and third-group mutant characters and specific V-shaped chromosomes. Such direct proof had already been provided for certain sex-linked mutants and the rod-shaped chromosomes by the phenomena of non-disjunction of the X-chromosomes,[2] and more recently for the small round chromosome and the mutants of the "fourth" group through study of "Diminished" individuals haploid for that chromosome because of non-disjunction.[3]

In the triploid strain individuals triploid for the fourth-chromosome alone have been identified as a distinct somatic type, tested genetically in a variety of ways, and proved to be such by direct cytological examination.

A significant new conclusion proved by the intersexes is that sex in *D. melanogaster* is determined by a balance between the genes contained in the X-chromosome and those contained in the autosomes. It is not the simple possession of two X-chromosomes that makes a female, and of one that makes a male. A preponderance of genes that are in the autosomes tend toward the production of male characters; and the net effect of genes in the X is a tendency to the production of female characters. The ratio of $2X$: 2 *sets autosomes,* or $3X$: 3 *sets autosomes* (or $1X$: 1 *set autosome?*) produces a female, while $1X$: 2 *sets autosomes* produces a male. An intermediate ratio, $2X$: 3 *sets autosomes,* produces an intermediate condition—the intersex. The fourth-chromosome seems to have a disproportionately large share of the total male-producing genes; for there are indications that the triplo-fourth intersexes are preponderantly of the "male-type," while the diplo-fourth intersexes are mainly "female-type."

The condition $3X$: 2 *sets autosomes* should be "super-females," and $1X$: 3 *sets autosomes* "super-males." Triploid females produce a

[2] *Genetics,* 1, 1916.

[3] In press, *Proc. Nat'l Acad.*

small proportion of males that are somatically quite different from males and from intersexes and that are sterile. There is genetical evidence that these males are $1X : 3$ *sets autosomes* in constitution. Studies of "high non-disjunction" show that triplo-X individuals ordinarily die, but in certain lines they occasionally survive as females that are somatically quite different from diploid or triploid females and that are sterile. Such females occur also in the progeny of triploid females; and, in the case of those produced by non-disjunction, both genetical and cytological proofs of their constitution ($3X : 2$ *sets autosomes*) are now complete.

Calvin B. Bridges

THE AMERICAN CHEMICAL SOCIETY

(*Concluded*)

DIVISION OF DYE CHEMISTRY

A. B. Davis, *chairman*
R. Norris Shreve, *secretary*

Contribution to the estimation of H acid: H. R. Lee. The stability of diazo-benzene and p-diazo-toluene is taken up from the standpoint of their use as standard volumetric solutions. Data showing the relative stability of these diazo salts both in acid and alkaline solution are presented. Tables showing comparative analyses of a large number of samples of commercial and pure H acids are given. The method used by the Newport Company for the analysis of H acid is outlined. The use of p-diazo-toluene for the analysis of a number of amino-naphthol-sulfonic acids other than H acid is suggested.

A new alizarin process: Chas. W. Schaffer. This process depends on a cheap process for manufacture of pyrocatechol and then the synthesis of alizarin according to Baeyer and Caro from pyrocatechol and phthalic anhydride. Phenol is nitrated and reduced wth zinc giving ortho and para amino-phenol. This is diazotized, not filtered and the diazo solution run directly into the still. In the distillation the diazonium chloride, being unstable, is decomposed—water and acid first coming off—and at 243–245° C. the pure pyrocatechol comes over. The p-amino-phenol may also be diazotized and sublimed, giving hydroquinone.

Bleaching of dyed cotton fabrics: J. Merritt Matthews. Owing to the demand of the American public for more cotton goods with larger variety of colors it was necessary to modify the old-fashioned method of bleaching in order to properly preserve the color and also to produce a satisfactory bleached fabric. The extension of cotton goods in the field of wearing apparel has been made possible to great degree by the fact that a variety of color effects can now be employed. This has been very beneficial to many of our manufacturing enterprises and has also made it possible to use the cheaper staple cotton in place of the more expensive staples of wool and silk. Furthermore, it has led to the development of apparel materials which can meet the conditions of modern treatment in the laundry. There is an ever increasing demand for faster dyes owing to the fact that modern methods of usage are such as to put a very severe burden on the color. It has been the endeavor of the dyestuff manufacturers to increase continually the line of such fast dyes for the purpose not only of enlarging the color palette, but also of simplifying the method of dyeing so that the dyer is not more inconvenienced by the use of these fast dyes than he would be by using the more fugitive colors.

The immediate needs of chemistry in America: William J. Hale. The industries are fast ridding themselves of poorly trained chemists and hence the recent period of business depression has come in this respect like a godsend to chemistry in America. A classification of chemists everywhere is attempted. In order that industrial advancement may be made all the more apparent, the highest development of the several classes of chemists is an absolute necessity. Four distinct factors constitute the immediate needs of chemistry in America, the most pertinent being the development of chemists with engineering training. In fact, physics and engineering are no less important than chemistry itself in the training of the young chemist. The greatest need for the future as well as for the present is the collaboration of universities and industries upon researches which take their rise from industrial problems.

Contribution to the chemistry of malachite green: Joseph R. Minevitch. Tetramethyldiamidotriphenyl methane, which is prepared by the condensation of dimethylaniline and benzaldehyde in the presence of hydrochloric acid, when oxidized with lead peroxide as a solution of the dihydrochloride either with or without sufficient acetic acid does not give exclusively the tetramethyldiamidotriphenyl carbinol. The tetracarbinol possesses crystalline properties and forms mala-

chite green crystals either as the oxalate or the zinc double chloride salt. What actually does form in this reaction is a mixture of carbinols, one of which—probably a triphenyl derivative—possesses little or no crystalline properties and forms amorphous salts with oxalic acid or zinc chloride. Hydrochloric acid corresponding to the methane dihydrochloride and in the presence of at least 2.25 molecules of acetic acid gives the maximum of tetramethyl derivative. Oxidation without acetic acid produces a carbinol or a mixture of carbinols which is so weak in crystalline properties as to form little or none of the crystalline malachite green salts.

Imports of dyes by classes during 1920: C. R. DE LONG. The following import statistics are presented:

Vat dyes other than indigo.	855,000 lbs.
Mordant and chrome dyes...	840,000 lbs.
Acid dyes	765,000 lbs.
Direct dyes	595,000 lbs.
Sulfur dyes	255,000 lbs.
Basic dyes	200,000 lbs.
Indigo	171,000 lbs.

Dyes derived from beta-oxynaphthoic acid and from J-acid with reference to the Chemical Foundation patents: A. WILLIARD JOYCE. The colors made from beta-oxynaphthoic acid are mostly insoluble in water and oil, and are of special interest to the makers of lake-pigments. Those derived from the arylamides of beta-oxynaphthoic acid are of value as pigments and also as colors developed directly on cotton when used in combination with a diazotized arylamine. This class of colors has been developed chiefly by the German firms of Meister Lucius and Bruning and Griesheim-Elektron. The dyes derived from J-acid are valuable direct cotton colors of good fastness, especially to acids and of great clearness and brilliancy of shade. These colors from J-acid and J-acid derivatives have been greatly developed by leading German dye manufacturers: the Bayer Company, Cassella and Co., Meister Lucius and Bruning, and Kalle and Co. The Chemical Foundation, Inc., owns patents which cover dyes made from the above intermediates.

The quantitative determination of phenanthrene: ARTHUR G. WILLIAMS. Phenanthrene in crude phenanthrenes may be quantitatively determined by oxidation in glacial acetic acid solution by iodic acid to phenanthraquinone followed by precipitation of the quinone, also in glacial acetic acid solution, as toluphenanthrazine by 3,4-tolylene diamine. The hydrocarbon may be conveniently detected qualitatively by oxidation in glacial acetic acid solution by means of $KBrO_3$ or HIO_3 followed by precipitation by water, filtration, extraction of the residue by $NaHSO_3$, liberation of the quinone by means of HCl and $FeCl_3$, extraction with CCl_4, and final detection of phenanthraquinone by means of the Hilpert and Wolf test with $SbCl_5$ in CCl_4.

Alkali fusions. III. Fusions of phenylglycine o-carboxylic acid with potassium hydroxide and with sodium hydroxide for the production of indigo: MAX PHILLIPS.

Vapor pressure determinations on naphthalene, anthracene, phenanthrene, and anthraquinone between their melting and boiling points: O. A. NELSON and C. E. SENSEMAN.

Nomenclature of dyestuff intermediates: J. WARREN KINSMAN.

SECTION OF PETROLEUM CHEMISTRY

T. G. Delbridge, *chairman*
W. A. Gruse, *secretary*

Petroleum hydrocarbons that can not be distilled: C. F. MABERY.

Petroleum: a raw material for our chemical industries: SIDNEY BORN.

Some chemical considerations of petroleum refining: B. T. BROOKS. Chemical investigation has played a relatively unimportant part in the petroleum industry. Reasons advanced for this are: (1) Petroleum has been plentiful and crude methods profitable. (2) Research has been regarded as unprofitable "wild catting." (3) Initiative and spirit of research has been killed by the policy of secrecy. (4) Petroleum technologists are unorganized and inarticulate. (5) Fundamental or theoretical research in this branch of organic chemistry has been comparatively neglected. (6) Chemists have been poorly and narrowly trained. Several factors which are improving this situation are given. It is important to minimize refining losses. Many opinions previously held in regard to olefines are untenable.

Oil shale: R. F. BACON.

Determination of gasoline in natural and casinghead gas: CHARLES SKEELE PALMER.

Dechlorination of chlorohydrocarbons: W. F. FARAGHER and F. H. GARNER.

Determination of moisture in transformer oils: C. J. RODMAN.

Viscosity—temperature curves of fractions of typical American crude oils: E. W. Dean and F. W. Lane.

Iodine numbers of unsaturated hydrocarbons and cracked gasolines: W. F. Faragher, F. H. Garner and W. A. Gruse.

The reclamation of used motor oils: William F. Parish. The disposal of used motor oils is becoming a serious problem. The chief reason for their poor quality, as recovered from the motor, is the dilution with approximately 30 per cent. of heavy ends from motor fuel. By washing with a water solution of soda ash and distilling off the diluent, airplane motor oils were recovered ten times and more at one aviation camp during the war and gave better service than new oils. The improvement in recovered oils is due to the removal of low boiling constituents.

Total heats and condensation points of kerosene-air mixtures: Robert E. Wilson and D. P. Barnard.

A new method of color measurement for oils: Leon W. Parsons and Robert E. Wilson.

Catalytic oxidation of petroleum oils: C. E. Waters.

Viscosities of motor oils at high temperatures: L. B. Lockhart. (By title.)

DIVISION OF WATER, SEWERAGE AND SANITATION

W. P. Mason, *chairman*
W. W. Skinner, *secretary*

Reactions in the Dorr-Peck tank: A. M. Buswell.

Definition of alkalinity and temporary hardness: A. M. Buswell.

Notes on the analysis of mine drainage water: Joseph A. Shaw and N. A. Bailey.

Method for the determination of free and combined carbon dioxide: Joseph A. Shaw.

Radioactivity of miscellaneous waters examined in the Bureau of Chemistry: W. W. Skinner and J. W. Sale. Analyses of radioactivity of eleven spring waters collected at source by a representative of the Bureau of Chemistry, of eight river, lake and ocean waters, of fifteen commercial domestic bottled waters, and of twelve imported bottled waters, are tabulated. The significance of the data depends on the fact that no commercial bottled water of natural origin has been found to contain sufficient radioactivity, either temporary or permanent, to warrant its purchase by consumers because of its content of radioactivity. In order to obtain the minimum daily dose of emanation from the most radioactive sample examined, it would be necessary to consume 2,810 gallons of water daily, and to obtain the minimum daily dose of radioactive salt from the most radioactive sample examined, it would be necessary to consume 2,935 gallons of water daily. To obtain the maximum doses, it would be necessary to consume daily at least ten times these amounts, or 28,100 and 29,350 gallons of water respectively. It is concluded, therefore, that shippers of bottled waters are not justified in making any statments on the labels which will induce prospective consumers to purchase the articles because of their radioactivity.

A comparison of some miscellaneous samples of ocean, bay and lake waters: W. W. Skinner and W. E. Shaefer. In considering the composition of a water, two things must be borne in mind, (1) the amount of dissolved mineral matter per unit volume which may be termed the concentration of the water, and (2) the character or composition of this dissolved mineral matter. The waters of Chesapeake Bay near Chesapeake Beach, of the Gulf of Mexico off Galveston, Texas, of the Atlantic Ocean off Boston, and of the Pacific Ocean off San Francisco, while varying in concentration, are shown to contain the same constituents in almost exactly the same relative proportions. Therefore, the mineral matter dissolved in the rivers flowing into Chesapeake Bay and the Gulf of Mexico does not materially affect the composition of those waters. Although the concentration of the sea water is greater at rising tide than at falling tide, yet the percentage composition of the dissolved mineral matter in the water remains practically unaffected by the inflow and outflow of the tide. The mineral matter dissolved in certain North Dakota and Utah lakes is somewhat similar in composition to the mineral matter dissolved in Atlantic Ocean water. However, the difference in calcium content between these North Dakota and Utah lakes is noteworthy. The dissolved mineral matter in the three North Dakota lakes contains 4.54 per cent. calcium, while that in the six Utah lakes contains only 0.92 per cent. calcium. These lakes are from one fifteenth to two and three quarters times as concentrated as Atlantic Ocean water.

The present status of chlorination of public water supply: S. T. Powell.

Charles L. Parsons,
Secretary

SCIENCE

NEW SERIES
VOL. LIV, No. 1395

FRIDAY, SEPTEMBER 23, 1921

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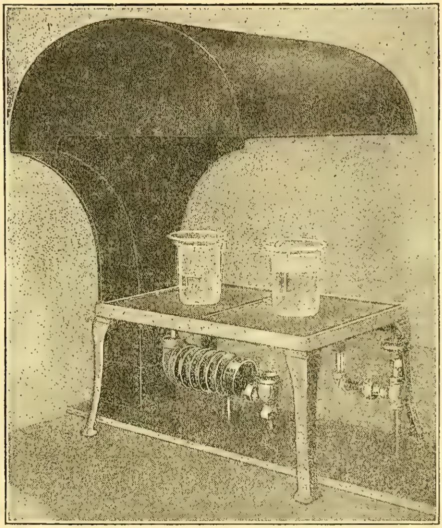

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SCIENCE

Friday, September 23, 1921

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

ADDRESS OF THE PRESIDENT OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

II

I turn now to a question of scientific interest which is attracting general attention at the present time. It is directly connected with Lord Kelvin's address fifty years ago.

The molecular theory of matter—a theory which in its crudest form has descended to us from the earliest times and which has been elaborated by various speculative thinkers through the intervening ages, hardly rested upon an experimental basis until within the memory of men still living. When Lord Kelvin spoke in 1871, the best-established development of the molecular hypothesis was exhibited in the kinetic theory of gases as worked out by Joule, Clausius, and Clerk-Maxwell. As he then said, no such comprehensive molecular theory had ever been even imagined before the nineteenth century. But, with the eye of faith, he clearly perceived that, definite and complete in its area as it was, it was "but a well-drawn part of a great chart, in which all physical science will be represented with every property of matter shown in dynamical relation to the whole. The prospect we now have of an early completion of this chart is based on the assumption of atoms. But there can be no permanent satisfaction to the mind in explaining heat, light, elasticity, diffusion, electricity and magnetism, in gases, liquids and solids, and describing precisely the relations of these different states of matter to one another by statistics of great numbers of atoms when properties of the atom itself are simply assumed. When the theory, of which we have the first instalment in Clausius and Maxwell's work, is complete, we are but brought face to face with a superlatively grand ques-

[1] Edinburgh, September 7, 1921.

tion: "What is the inner mechanism of the atom?"

If the properties and affections of matter are dependent upon the inner mechanism of the atom, an atomic theory, to be valid, must comprehend and explain the all. There can not be one kind of atom for the physicist and another for the chemist. The nature of chemical affinity and of valency, the modes of their action, the difference in characteristics of the chemical elements, even their number, internal constitution, periodic position, and possible isotopic rearrangements must be accounted for and explained by it. Fifty years ago chemists, for the most part, rested in the comfortable belief of the existence of atoms in the restricted sense in which Dalton, as a legacy from Newton, had imagined them. Lord Kelvin, unlike the chemists, had never been in the habit of "evading questions as to the hardness or indivisibility of atoms by virtually assuming them to be infinitely small and infinitely numerous." Nor, on the other hand, did he realize, with Boscovich, the atom "as a mystic point endowed with inertia and the attribute of attracting or repelling other such centers." Science advances not so much by fundamental alterations in its beliefs as by additions to them. Dalton would equally have regarded the atom "as a piece of matter of measurable dimensions, with shape, motion, and laws of action, intelligible subjects of scientific investigation."

In spite of the fact that the atomic theory, as formulated by Dalton, has been generally accepted for nearly a century, it is only within the last few years that physicists have arrived at a conception of the structure of the atom sufficiently precise to be of service to chemists in connection with the relation between the properties of elements of different kinds, and in throwing light on the mechanism of chemical combination.

This further investigation of the "superlatively grand question—the inner mechanism of the atom,"—has profoundly modified the basic conceptions of chemistry. It has led to a great extension of our views concerning the real nature of the chemical elements. The discovery of the electron, the production of helium in the radioactive disintegration of atoms, the recognition of the existence of isotopes, the possibility that all elementary atoms are composed either of helium atoms or of atoms of hydrogen and helium, and that these atoms, in their turn, are built up of two constituents, one of which is the electron, a particle of negative electricity whose mass is only 1/1800 of that of an atom of hydrogen, and the other a particle of positive electricity whose mass is practically identical with that of the same atom—the outcome, in short, of the collective work of Soddy, Rutherford, J. J. Thomson, Collie, Moseley and others—are pregnant facts which have completely altered the fundamental aspects of the science. Chemical philosophy has, in fact, now definitely entered on a new phase.

Looking back over the past, some indications of the coming change might have been perceived wholly unconnected, of course, with the recent experimental work which has served to ratify it. In a short paper entitled "Speculative ideas respecting the constitution of matter," originally published in 1863, Graham conceived that the various kinds of matter, now recognized as different elementary substances, may possess one and the same ultimate or atomic molecule existing in different conditions of movement. This idea, in its essence, may be said to be as old as the time of Leucippus. To Graham as to Leucippus "the action of the atom as one substance taking various forms by combinations unlimited, was enough to account for all the phenomena of the world. By separation and union with constant motion all things could be done." But Graham developed the conception by independent thought, and in the light of experimentally ascertained knowledge which the world owes to his labors. He might have been cognizant of the speculations of the Greeks, but there is no evidence that he was knowingly influenced by them. In his paper Graham uses the terms atom and molecule if not exactly in the same sense that modern teaching de-

mands, yet very differently from that hitherto required by the limitations of contemporary chemical doctrine. He conceives of a lower order of atoms than the chemical atom of Dalton, and founds on his conception an explanation of chemical combination based upon a fixed combining measure, which he terms the *metron*, its relative weight being one for hydrogen, sixteen for oxygen, and so on with the other so-called "elements." Graham, in fact, like Davy before him, never committed himself to a belief in the indivisibility of the Daltonian atom. The original atom may, he thought, be far down.

The idea of a primordial ylé, or of the essential unity of matter, has persisted throughout the ages, and in spite of much experimental work, some of it of the highest order, which was thought to have demolished it, it has survived, revivified and supported by analogies and arguments drawn from every field of natural inquiry. This idea of course was at the basis of the hypothesis of Prout, but which, even as modified by Dumas, was held to be refuted by the monumental work of Stas. But, as pointed out by Marignac and Dumas, any one who will impartially look at the facts can hardly escape the feeling that there must be some reason for the frequent recurrence of atomic weights differing by so little from the numbers required by the law which the work of Stas was supposed to disprove. The more exact study within recent years of the methods of determining atomic weights, the great improvement in experimental appliances and technique, combined with a more rigorous standard of accuracy demanded by a general recognition of the far-reaching importance of an exact knowledge of these physical constants, has resulted in intensifying the belief that some natural law must be at the basis of the fact that so many of the most carefully determined atomic weights on the oxygen standard are whole numbers. Nevertheless there were well authenticated exceptions which seemed to invalidate its universality. The proved fact that a so-called element may be a mixture of isotopes—substances of the same chemical attributes but of varying atomic weight—has thrown new light on the question. It is now recognized that the fractional values independently established in the case of any one element by the most accurate experimental work of various investigators are, in effect, "statistical quantities" dependent upon a mixture of isotopes. This result, indeed, is a necessary corollary of modern conceptions of the inner mechanism of the atom. The theory that all elementary atoms are composed of helium atoms, or of helium and hydrogen atoms, may be regarded as an extension of Prout's hypothesis, with, however, this important distinction, that whereas Prout's hypothesis was at best a surmise, with little, and that little only weak, experimental evidence to support it, the new theory is directly deduced from well-established facts. The hydrogen isotope H_3, first detected by J. J. Thomson, of which the existence has been confirmed by Aston, would seem to be an integral part of atomic structure. Rutherford, by the disruption of oxygen and nitrogen has also isolated a substance of mass 3 which enters into the structure of atomic nuclei, but which he regards as an isotope of helium, which itself is built up of four hydrogen nuclei together with two cementing electrons. The atomic nuclei of elements of even atomic number would appear to be composed of helium nuclei only, or of helium nuclei with cementing electrons; whereas those of elements of odd atomic number are made up of helium and hydrogen nuclei together with cementing electrons. In the case of the lighter elements of the latter class the number of hydrogen nuclei associated with the helium nuclei is invariably three, except in that of nitrogen where it is two. The frequent occurrence of this group of three hydrogen nuclei indicates that it is structurally an isotope of hydrogen with an atomic weight of three and a nuclear charge of one. It is surmised that it is identical with the hypothetical "nebulium" from which our "elements" are held by astro-physicists to

be originally produced in the stars through hydrogen and helium.

These results are of extraordinary interest as bearing on the question of the essential unity of matter and the mode of genesis of the elements. Members of the British Association may recall the suggestive address on this subject of the late Sir William Crookes, delivered to the Chemical Section at the Birmingham meeting of 1886, in which he questioned whether there is absolute uniformity in the mass of the atoms of a chemical element, as postulated by Dalton. He thought, with Marignac and Schutzenberger, who had previously raised the same doubt, that it was not improbable that what we term an atomic weight merely represents a mean value around which the actual weights of the atoms vary within narrow limits, or, in other words, that the mean mass is "a statistical constant of great stability." No valid experimental evidence in support of this surmise was or could be offered at the time it was uttered. Maxwell pointed out that the phenomena of gaseous diffusion, as then ascertained, would seem to negative the supposition. If hydrogen, for example, were composed of atoms of varying mass it should be possible to separate the lighter from the heavier atoms by diffusion through a porous septum. "As no chemist," said Maxwell, "has yet obtained specimens of hydrogen differing in this way from other specimens, we conclude that all the molecules of hydrogen are of sensibly the same mass, and not merely that their mean mass is a statistical constant of great stability."[1] But against this it may be doubted whether any chemist had ever made experiments sufficiently precise to solve this point.

The work of Sir Norman Lockyer on the spectroscopic evidence for the dissociation of "elementary" matter at transcendental temperatures, and the possible synthetic intro-stellar production of elements, through the helium of which he originally detected the existence, will also find its due place in the history of this new philosophy.

[1] Clerk-Maxwell, Art. "Atom," *Ency. Brit.*, 9th Ed.

Sir J. J. Thomson was the first to afford direct evidence that the atoms of an element, if not exactly of the same mass, were at least approximately so, by his method of analysis of positive rays. By an extension of this method Mr. F. W. Aston has succeeded in showing that a number of elements are in reality mixtures of isotopes. It has been proved, for example, that neon, which has a mean atomic weight of about 20.2, consists of two isotopes having the atomic weights respectively of 20 and 22, mixed in the proportion of 90 per cent. of the former with 10 per cent. of the latter. By fractional diffusion through a porous septum an apparent difference of density of 0.7 per cent. between the lightest and heaviest fractions was obtained. The kind of experiment which Maxwell imagined proved the invariability of the hydrogen atom has sufficed to show the converse in the case of neon.

The element chlorine has had its atomic weight repeatedly determined, and, for special reasons, with the highest attainable accuracy. On the oxygen standard it is 35.46, and this value is accurate to the second decimal place. All attempts to prove that it is a whole number—35 or 36—have failed. When, however, the gas is analyzed by the same method as that used in the case of neon it is found to consist of at least two isotopes of relative mass 35 and 37. There is no evidence whatever of an individual substance having the atomic weight 35.46. Hence chlorine is to be regarded as a complex element consisting of two principal isotopes of atomic weights 35 and 37 present in such proportion as to afford the mean mass 35.46. The atomic weight of chlorine has been so frequently determined by various observers and by various methods with practically identical results that it seems difficult to believe that it consists of isotopes present in definite and invariable proportion. Mr. Aston meets this objection by pointing out that all the accurate determinations have been made with chlorine derived originally from the same source, the sea, which has been perfectly mixed for æons. If samples of the element could be obtained from some

other original source it is possible that other values of atomic weight would be obtained, exactly as in the case of lead in which the existence of isotopes in the metal found in various radioactive minerals was first conclusively established.

Argon, which has an atomic weight of 39.88, was found to consist mainly of an atomic weight of 40, associated to the extent of about 3 per cent. with an isotope of atomic weight 36. Krypton and xenon are far more complex. The former would appear to consist of six isotopes, 78, 80, 82, 83, 84, 86; the latter of five isotopes, 129, 131, 132, 134, 136.

Fluorine is a simple element of atomic weight 19. Bromine consists of equal quantities of two isotopes, 79 and 81. Iodine, on the contrary, would appear to be a simple element of atomic weight 127. The case of tellurium is of special interest in view of its periodic relation to iodine, but the results of its examination up to the present are indefinite.

Boron and silicon are complex elements, each consisting of two isotopes, 10 and 11, and 28 and 29, respectively.

Sulphur, phosphorus, and arsenic are apparently simple elements. Their accepted atomic weights are practically integers.

All this work is so recent that there has been little opportunity, as yet, of extending it to any considerable number of the metallic elements. These, as will be obvious from the nature of the methods employed, present special difficulties. It is, however, highly probable that mercury is a mixed element consisting of many isotopes. These have been partially separated by Brönsted and Hervesy by fractional distillation at very low pressures, and have been shown to vary very slightly in density. Lithium is found to consist of two isotopes, 6 and 7. Sodium is simple, potassium and rubidium are complex, each of the two latter elements consisting, apparently, of two isotopes. The accepted atomic weight of cæsium, 132.81, would indicate complexity, but the mass spectrum shows only one line at 133. Should this be confirmed cæsium would afford an excellent test case. The accepted value for the atomic weight is sufficiently far removed from a whole number to render further investigation desirable.

This imperfect summary of Mr. Aston's work is mainly based upon the account he recently gave to the Chemical Society. At the close of his lecture he pointed out the significance of the results in relation to the Periodic Law. It is clear that the order of the chemical or "mean" atomic weights in the periodic table has no practical significance; anomalous cases such as argon and potassium are simply due to the relative proportions of their heavier and lighter isotopes. This does not necessarily invalidate or even weaken the periodic law which still remains the expression of a great natural truth. That the expression as Mendeléeff left it is imperfect has long been recognized. The new light we have now gained has gone far to clear up much that was anomalous, especially Moseley's discovery that the real sequence is the atomic number, not the atomic weight. This is one more illustration of the fact that science advances by additions to its beliefs rather than by fundamental or revolutionary changes in them.

The bearing of the electronic theory of matter, too, on Prout's discarded hypothesis that the atoms of all elements were themselves built up of a primordial atom—his *protyle* which he regarded as probably identical with hydrogen—is too obvious to need pointing out. In a sense Prout's hypothesis may be said to be now reestablished, but with this essential modification—the primordial atoms he imagined are complex and are of two kinds—atoms of positive and negative electricity—respectively known as protons and electrons. These, in Mr. Aston's words, are the standard bricks that nature employs in her operations of element building.

The true value of any theory consists in its comprehensiveness and sufficiency. As applied to chemistry, this theory of "the inner mechanism of the atom" must explain all its phenomena. We owe to Sir J. J. Thomson its extension to the explanation of the periodic law, the atomic number of an element, and

of that varying power of chemical combination in an element we term valency. This explanation I give substantially in his own words. The number of electrons in an atom of the different elements has now been determined, and has been found to be equal to the atomic number of the element, that is to the position which the element occupies in the series when the elements are arranged in the order of their atomic weights. We know now the nature and quantity of the materials of which the atoms are made up. The properties of the atom will depend not only upon these factors but also upon the way in which the electrons are arranged in the atom. This arrangement will depend on the forces between the electrons themselves and also on those between the electrons and the positive charges or protons. One arrangement which naturally suggested itself is that the positive charges should be at the center with the negative electrons around it on the surface of a sphere. Mathematical investigation shows that this is a possible arrangement if the electrons on the sphere are not too crowded. The mutual repulsion of the electrons resents overcrowding, and Sir J. J. Thomson has shown that when there are more than a certain number of electrons on the sphere, the attraction of a positive charge, limited as in the case of the atom in magnitude to the sum of the charges on the electrons, is not able to keep the electrons in stable equilibrium on the sphere, the layer of electrons explodes and a new arrangement is formed. The number of electrons which can be accommodated on the outer layer will depend upon the law of force between the positive charge and the electrons. Sir J. J. Thomson has shown that this number will be eight with a law of force of a simple type.

To show the bearing of this result as affording an explanation of the Periodic Law, let us, to begin with, take the case of the atom of lithium, which is supposed to have one electron in the outer layer. As each element has one more free electron in its atom than its predecessor, glucinum, the element next in succession to lithium, will have two electrons in the outer layer of its atom, boron will have three, carbon four, nitrogen five, oxygen six, fluorine seven and neon eight. As there can not be more than eight electrons in the outer layer, the additional electron in the atom of the next element, sodium, can not find room in the same layer as the other electrons, but will go outside, and thus the atom of sodium, like that of lithium, will have one electron in its outer layer. The additional electron, in the atom of the next element, magnesium, will join this, and the atom of magnesium, like that of glucinum, will have two electrons in the outer layer. Again, aluminium, like boron, will have three; silicon, like carbon, four; phosphorus, like nitrogen, five; sulphur, like oxygen, six; chlorine, like fluorine, seven; and argon, like neon, eight. The sequence will then begin again. Thus the number of electrons, one, two, three, up to eight in the outer layer of the atom, will recur periodically as we proceed from one element to another in the order of their atomic weights, so that any property of an element which depends on the number of electrons in the outer layer of its atom will also recur periodically, which is precisely that remarkable property of the elements which is expressed by the periodic law of Mendeléeff, or the law of octaves of Newlands.

The valency of the elements, like their periodicity, is a consequence of the principle that equilibrium becomes unstable when there are more than eight electrons in the outer layer of the atom. For on this view the chemical combination between two atoms, A and B, consists in the electrons of A getting linked up with those of B. Consider an atom like that of neon, which has already eight electrons in its outer layer; it can not find room for any more, so that no atoms can be linked to it, and thus it can not form any compounds. Now take an atom of flourine, which has seven electrons in its outer layer; it can find room for one, but only one, electron, so that it can unite with one, but not with more than one, atom of an element like hydrogen, which has one electron in the

outer layer. Fluorine, accordingly, is monovalent. The oxygen atom has six electrons; it has, therefore, room for two more, and so can link up with two atoms of hydrogen: hence oxygen is divalent. Similarly nitrogen, which has five electrons and three vacant places, will be trivalent, and so on. On this view an element should have two valencies, the sum of the two being equal to eight. Thus, to take oxygen as an example, it has only two vacant places, and so can only find room for the electrons of two atoms; it has, however, six electrons available for filling up the vacant places in other atoms, and as there is only one vacancy to be filled in a fluorine atom the electrons in an oxygen atom could fill up the vacancies in six fluorine atoms, and thereby attach these atoms to it. A fluoride of oxygen of this composition remains to be discovered, but its analogue, SF_6, first made known by Moissan, is a compound of this type. The existence of two valencies for an element is in accordance with views put forward some time ago by Abegg and Bödlander. Professor Lewis and Mr. Irving Langmuir have developed, with great ingenuity and success, the consequences which follow from the hypothesis that an octet of electrons surrounds the atoms in chemical compounds.

The term "atomic weight" has thus acquired for the chemist an altogether new and much wider significance. It has long been recognized that it has a far deeper import than as a constant useful in chemical arithmetic. For the ordinary purposes of quantitative analysis, of technology, and of trade, these constants may be said to be now known with sufficient accuracy. But in view of their bearing on the great problem of the essential nature of matter and on the "superlatively grand question, What is the inner mechanism of the atom?" they become of supreme importance. Their determination and study must now be approached from entirely new standpoints and by the conjoint action of chemists and physicists. The existence of isotopes has enormously widened the horizon. At first sight it would appear that we should require to know as many atomic weights as there are isotopes, and the chemist may be appalled at such a prospect. All sorts of difficulties start up to affright him, such as the present impossibility of isolating isotopes in a state of individuality, their possible instability, and the inability of his quantitative methods to establish accurately the relatively small differences to be anticipated. All this would seem to make for complexity. On the other hand, it may eventually tend towards simplification. If, with the aid of the physicist we can unravel the nature and configuration of the atom of any particular element, determine the number and relative arrangement of the constituent protons and electrons, it may be possible to arrive at the atomic weight by simple calculation, on the assumption that the integer rule is mathematically valid. This, however, is almost certainly not the case, owing to the influence of "packing." The little differences, in fact, may make all the difference. The case is analogous to that of the so-called gaseous laws in which the departures from their mathematical expression have been the means of elucidating the physical constitution of the gases and of throwing light upon such variations in their behavior as have been observed to occur. There would appear, therefore, ample scope for the chemist in determining with the highest attainable accuracy the departures from the whole-number rule, since it is evident that much depends upon their exact extent.

These considerations have already engaged the attention of chemists. For some years past, a small international committee, originally appointed in 1903, has made and published an annual report in which they have noted such determinations of atomic weight as have been made during the year preceding each report, and they have from time to time made suggestions for the amendment of the tables of atomic weights, published in textbooks and chemical journals, and in use in chemical laboratories. In view of recent developments, the time has now arrived when the work of this international committee must

be reorganized and its aims and functions extended. The mode in which this should be done has been discussed at the meeting in Brussels, in June last, of the International Union of Chemistry Pure and Applied, and has resulted in strengthening the constitution of the committee and in a wide extension of its scope.

The crisis through which we have recently passed has had a profound effect upon the world. The spectacle of the most cultured and most highly developed peoples on this earth, armed with every offensive appliance which science and the inventive skill and ingenuity of men could suggest, in the throes of a death struggle must have made the angels weep. That dreadful harvest of death is past, but the aftermath remains. Some of it is evil, and the evil will persist for, it may be, generations. There is, however, an element of good in it, and the good, we trust, will develop and increase with increase of years. The whole complexion of the world—material, social, economic, political, moral, spiritual—has been changed, in certain aspects immediately for the worse, in others prospectively for the better. It behooves us, then, as a nation to pay heed to the lessons of the war.

The theme is far too complicated to be treated adequately within the limits of such an address as this. But there are some aspects of it germane to the objects of this association, and I venture, therefore, in the time that remains to me, to bring them to your notice.

The Great War differed from all previous internecine struggles in the extent to which organized science was invoked and systematically applied in its prosecution. In its later phases, indeed, success became largely a question as to which of the great contending parties could most rapidly and most effectively bring its resources to their aid. The chief protagonists had been in the forefront of scientific progress for centuries, and had an accumulated experience of the manifold applications of science in practically every department of human activity that could have any possible relation to the conduct of war. The military class in every country is probably the most conservative of all the professions and the slowest to depart from tradition. But when nations are at grips, and they realize that their very existence is threatened, every agency that may tend to cripple the adversary is apt to be resorted to—no matter how far it departs from the customs and conventions of war. This is more certain to be the case if the struggle is protracted. We have witnessed this fact in the course of the late war. Those who, realizing that in the present imperfect stage of civilization, wars are inevitable, yet strove to minimize their horrors, and who formulated the Hague Convention of 1899, were well aware how these horrors might be enormously intensified by the applications of scientific knowledge, and especially of chemistry. Nothing shocked the conscience of the civilized world more than Germany's cynical disregard of the undertaking into which she had entered with other nations in regard, for instance, to the use of lethal gas in warfare. The nation that treacherously violated the Treaty of Belgium, and even applauded the action, might be expected to have no scruples in repudiating her obligations under the Hague Convention. April 25, 1915, which saw the clouds of the asphyxiating chlorine slowly wafted from the German trenches towards the lines of the Allies, witnessed one of the most bestial episodes in the history of the Great War. The world stood aghast at such a spectacle of barbarism. German *Kultur* apparently had absolutely no ethical value. Poisoned weapons are employed by savages, and noxious gas had been used in Eastern warfare in early times, but its use was hitherto unknown among European nations. How it originated among the Germans—whether by the direct unprompted action of the Higher Command, or, as is more probable, at the instance of persons connected with the great manufacturing concerns in Rhineland, has, so far as I know, not transpired. It was not so used in the earlier stages of the war, even when it had become a war of position. It is notorious that the great chemical manufacturing establishments of

Germany had been, for years previously, sedulously linked up in the service of the war which Germany was deliberately planning—probably, in the first instance, mainly for the supply of munitions and medicaments. We may suppose that it was the tenacity of our troops, and the failure of repeated attempts to dislodge them by direct attack, that led to the employment of such foul methods. Be this as it may, these methods became part of the settled practise of our enemies, and during the three succeeding years, that is from April, 1915, to September, 1918, no fewer than eighteen different forms of poison—gases, liquids and solids—were employed by the Germans. On the principle of Vespasian's law, reprisals became inevitable, and for the greater part of three years we had the sorry spectacle of the leading nations of the world flinging the most deadly products at one another that chemical knowledge could suggest and technical skill contrive. Warfare, it would seem, has now definitely entered upon a new phase. The horrors which the Hague Convention saw were immanent, and from which they strove to protect humanity, are now, apparently, by the example and initiative of Germany, to become part of the established procedure of war. Civilization protests against a step so retrograde. Surely comity among nations should be adequate to arrest it. If the League of Nations is vested with any real power, it should be possible for it to devise the means, and to ensure their successful application. The failure of the Hague Convention is no sufficient reason for despair. The moral sense of the civilized world is not so dulled but that, if roused, it can make its influence prevail. And steps should be taken without delay to make that influence supreme, and all the more so that there are agencies at work which would seek to perpetuate such methods as a recognized procedure of war. The case for what is called chemical warfare has not wanted for advocates. It is argued that poison gas is far less fatal and far less cruel than any other instrument of war. It has been stated that "amongst the 'mustard gas' casualties the deaths were less than 2 per cent., and when death did not ensue complete recovery generally ultimately resulted. . . . Other materials of chemical warfare in use at the Armistice do not kill at all; they produce casualties which, after six weeks in hospital, are discharged practically without permanent hurt." It has been argued that, as a method of conducting war, poison-gas is more humane than preventive medicine. Preventive medicine has increased the unit dimension of an army, free from epidemic and communicable disease, from 100,000 men to a million. "Preventive medicine has made it possible to maintain 20,000,000 men under arms and abnormally free from disease, and so provided greater scope for the killing activities of the other military weapons. . . . Whilst the surprise effects of chemical warfare aroused anger as being contrary to military tradition, they were minute compared with those of preventive medicine. The former slew its thousands, whilst the latter slew its millions and is still reaping the harvest." This argument carries no conviction. Poison gas is not merely contrary to European military tradition; it is repugnant to the right feeling of civilized humanity. It in no wise displaces or supplants existing instruments of war, but creates a new kind of weapon, of limitless power and deadliness. "Mustard gas" may be a comparatively innocuous product as lethal substances go. It certainly was not intended to be such by our enemies. Nor, presumably, were the Allies any more considerate when they retaliated with it. Its effects, indeed, were sufficiently terrible to destroy the German *morale*. The knowledge that the Allies were preparing to employ it to an almost boundless extent was one of the factors that determined our enemies to sue for the Armistice. But if poisonous chemicals are henceforth to be regarded as a regular means of offence in warfare, is it at all likely that their use will be confined to "mustard gas," or indeed to any other of the various substances which were employed up to the date of the Armistice? To one who, after the peace, inquired in Germany concerning the German methods of making

"mustard gas," the reply was:— "Why are you worrying about this when you know perfectly well that this is not the gas we shall use in the next war?"

I hold no brief for preventive medicine, which is well able to fight its own case. I would only say that it is the legitimate business of preventive medicine to preserve by all known means the health of any body of men, however large or small, committed to its care. It is not to its discredit if, by knowledge and skill, the numbers so maintained run into millions instead of being limited to thousands. On the other hand, "an educated public opinion" will refuse to give credit to any body of scientific men who employ their talents in devising means to develop and perpetuate a mode of warfare which is abhorrent to the higher instincts of humanity.

This association, I trust, will set its face against the continued degradation of science in thus augmenting the horrors of war. It could have no loftier task than to use its great influence in arresting a course which is the very negation of civilization.

T. Edward Thorpe

AERIAL OBSERVATION OF EARTHQUAKE RIFTS

The Seismological Society of America is interested in mapping the earthquake rifts of California, with a view to increasing our knowledge of the structures related to earthquakes and to promoting security in the engineering work of the state. Data of a general and comprehensive character already exist in published and unpublished maps, but additional surveys are desirable. Faults may be located in several ways and it is possible that a method of tracing them may be developed with the airplane, as was first suggested to the writer by H. O. Wood. To test the idea, a flight was made by me from San Francisco to Los Angeles and return on June 9 and 11, so far as practicable over the San Andreas Rift, to observe and photograph it.

The plane was furnished by the Air Service of the U. S. Army, by courtesy of Major H. H. Arnold, under authority of General C. T. Menoher, chief. The aviator was Sergeant T. J. Fowler. The photographic equipment consisted of a mapping camera, K.1 model, fixed in the bottom of the plane. This camera is designed to take successive pictures automatically and can be so adjusted for the altitude of the plane and the apparent air speed that the exposures take a small overlap. The views can therefore be combined in a continuous mosaic. Theoretically the action should be perfect and the continuity of the pictures unbroken. In practise, the tilting of the plane is equivalent to turning a camera through a greater or less angle on a tripod and successive views may jump interspaces of greater or less extent. One remedy, with this type of camera, would be to repeat, a recourse which is practicable when flying over a restricted area, but impracticable in a flight between distant landing fields. A clinometer would enable the photographer to note the inclination of the plane and a finder might be used.

The flights here noted covered a course of approximately 400 miles each way and were made in 4 hours 40 minutes on the southward trip and 4 hours 13 minutes on the northward.

The San Andreas Rift, the object of observation, is that major continental structure which extends from Humboldt County in northern California to the Mohave Desert in the southern part of the state, a distance of about 600 miles. It is an ancient fault, the locus of innumerable movements, which have given rise to pronounced topographic features. Displacements have been upward or downward or lateral along different sections of the fault or during different movements along the same section. We have yet much to learn about the effects of faulting expressed in the details of geology along the rift.

The earthquake of April, 1906, produced marked surface features, which were carefully studied by Branner, Gilbert, Lawson and other geologists and which have been fully described in the report of the California State Earthquake Commission, publication 87 of the Carnegie Institution of Washington. One is often asked to what extent those features are still

visible and the answer is that much depends upon the climatic conditions of any selected section. Where rainfall is abundant, vegetation vigorous and erosion efficient, there is not much to be seen after fifteen years; but under arid conditions the marks of the disturbance of 1857 survive plainly.

The essential fact is that the Rift is a line, and features peculiar to it must fall into line. The general position and course of this Rift being known, the observer was constantly noting valleys, lakes and ponds, ravines, washes or scars on the surface, which lined up with one another. From over Mussel Rock, where the Rift cuts the shore, the range along the Rift was plainly that of the axis of San Andreas and Crystal Springs Lakes, and was continued in the valley through Searles Lake and beyond to Black Mountain. Stevens Creek heads in that summit on the Rift, and flows for six miles along it. Thus for a distance of 33 miles the earthquake line is marked by major features of the topography, by valleys which are due to the cooperation of displacement and erosion. Similar valleys might be produced by erosion alone, and since the rocks are hidden by water, soil and vegetation, the aerial observer could not see the displacement. In this section the observer could infer, but could not demonstrate the existence of the Rift.

Continuing southeastward beyond Wright's Station on the Santa Cruz branch of the Southern Pacific the Rift traverses the western slope of the Santa Cruz Mountains near the summit, and determines the course of numerous small valleys which are the head-valleys of streams that flow south to Monterey Bay, but which contrary to what would be expected, range themselves into line parallel with the crest of the mountains. Along this same line there are numerous landslide scars and small ponds. No one or small group of these features would necessarily indicate the existence of the Rift, but their alignment over a distance of 25 miles would be strong presumptive evidence of it, and that alignment can be seen from the airplane. The only other way in which it can be demonstrated is by a study of an accurate topographic map, which is in itself, as it were, an airplane view. Thus for any section of an earthquake track which might be indicated by features similar to those occurring on the western slopes of the Santa Cruz Mountains observation by airplane would constitute a valuable method of investigation.

Passing to the middle section of the earthquake Rift where the aridity of the climate prevents the growth of vegetation, and limits the destructive work of erosion, the marks of the earthquake became more distinct and more continuous. Thus my notes read: "Mustang Ridge and Peach Tree Valley, Rift shows in serpentine slides in the ridge. Temblor Range, the line of the Rift shows like a light soil streak for miles ahead. Over Carrizo Plains at Wolforts, Rift shows up in a line of white washes easily lined up," and a little further along: "Rift shows plainly like a canal ditch."

The ditch-like character of the Rift along the northeast slope of Carrizo Plain has been noted by Fairbanks and others. It is remarkable, plainly visible from an altitude of 12,000 feet, like a large empty irrigation canal. I could see it perhaps 10 miles ahead till it was lost in the rosy dust haze.

At this point the aviator passed me a note: "Forty minutes more gas." I scaled off the distance to Bakersfield, the only landing place. It was 35 minutes away and we turned from the Rift.

Returning from Los Angeles on the 11th we flew along the southeastern section of the Rift from Tejon Pass up Cuddy Valley to San Emidio Peak. In this stretch it is marked by springs which give rise to alkali patches or to green mallins, the marshes peculiar to seepages in arid valleys. Its features are easily traceable because of their linear continuity.

Photographing from an airplane is less satisfactory than observing. When the camera is fixed on the plane, as it must be to secure continuity of views, there is the trouble of swinging already referred to. I myself lost the sense of horizontal or vertical and was

quite unconscious of the fact that the camera was winking at the mountain slope when I thought it was photographing the lake.

In the vertical view features are flattened. This is true for vision and is even more pronouncedly true in photographs. It would be desirable therefore to observe during the earlier and later hours of the day when shadows are strong. The swiftness of flight makes this practicable, since miles become short when expressed in minutes and a distant field of study can be reached quickly. Photography, however, requires the strongest light possible because the exposure must be very brief when the camera is moving a hundred miles an hour, and this requirement limits the available hours to those when shadows are weak or lacking. The effect of this limitation is yet to be worked out, but since rift features are to a great extent relief features, it is of consequence.

So far as the trial flights of June 9 and 11 go they seem to demonstrate that aerial observation of a linear structural feature such as an earthquake rift is practicable. If one end of a rift be known it can be followed by a man skilled in the interpretation of topographic forms. Or if a line of features be detected, it may be so traced as to demonstrate their continuity and to facilitate the closer examination which may be necessary to prove the existence of a fault. I conclude that the airplane can be used to advantage as a means of rapid geologic reconaissance to map large structural features.

Bailey Willis

SCIENTIFIC EVENTS

INTERNATIONAL EXPLORATION OF THE UPPER AIR[1]

International exploration of the upper air dates from 1896, when a conference took place at Petrograd. Methods of sounding the atmosphere, even to a height of 23 miles, were devised. By the use of drifting free balloons, and recording instruments carried up by kites and anchored balloons, an unexpected stratification of the atmosphere has been discovered. The temperature falls regularly up to a height averaging six or seven miles from the ground, lower over the equator, higher near the poles. But the upper air is arranged in vertical columns in which the temperature is constant with height at any particular time and place. Little is known as to the cause of this disposition, and less as to the influence it must have on other factors of wind and weather. Useful knowledge can be gained only from data obtained by the same methods at the same times at the largest possible number of stations. International cooperation is necessary. It was interrupted by the war, although all the combatants made extensive use of the latest meteorological methods for the practical objects of artillery, aviation, poison gas, and sound-ranging. It has now been resumed. The other day we gave an account of the proceedings of the first meeting since the war, held at Bergen, in the last week of July, under the presidency of Professor V. Bjerknes. The name of that distinguished Norwegian meteorologist is associated with a new theory of the weather in temperate latitudes, on which we commented a year ago. The theory briefly is that just as the poles are capped with snow so they are capped by a great mass of cold air. In a wavering line round each temperate zone this polar air meets the warm air from the equator abruptly. Along the front of contact the warm air rises over the cold stream. Cyclones and anticyclones are born of the contest. The professor urges the formation of a closely set chain of observing stations round the globe in the zone of struggle. Other meteorologists are more disposed to assign the causes of our weather to the vaster regions of the upper air. An international meteorological committee, to meet in London in September, has been appointed by the Commission, and is to give special attention to the polar theory. The progress of its labors will be followed with deep interest. There are few human activities which would not gain by the advance of meteorological science, and the future of aviation will be largely determined by it.

[1] From the London *Times*.

THE WORLD'S SUPPLY OF WHEAT

According to a report issued to the Department of Agriculture prospects for the world's

wheat supply, while not so satisfactory as was expected during the first part of the current season, show at the present time no cause for serious alarm. Estimates of the quantity of wheat harvested in 20 countries, including the United States, for 1921, total 2,461,430,000 bushels, compared with 2,384,143,000 bushels harvested last year according to data compiled by the Bureau of Markets and Crop Estimates, United States Department of Agriculture.

The 20 countries included in this estimate are the United States, Canada, Argentina, Chile, Uruguay, Belgium, Bulgaria, Finland, France, Greece, Hungary, Italy, Spain, British India, Japan, Algeria, Tunis, Union of South Africa, Australia, and New Zealand. These countries produced approximately 68 per cent. of the known wheat crop of the world during the years 1903–1913, according to the annual average production records of the bureau.

Although the long-sustained drought throughout the greater part of the Northern Hemisphere was a serious menace to the various crops in many countries, the fall-sown wheat has not been affected adversely so much as was at first supposed. On the contrary, the fall-sown wheat managed to obtain a firm hold on the soil and a fairly vigorous growth before the beginning of the drought.

Nearly all of northern and central Europe will have larger wheat crops this year than last, according to the last estimates made by the bureau, Belgium and Greece being the only countries in which smaller crops are expected.

Outside of Europe, British India was most seriously affected by the drought. The dryness and the hot winds that have prevailed throughout most of the growing season have resulted in the very low yield 250,469,000 bushels of wheat, or about 50,000,000 bushels less than the quantity normally consumed in that country. With the rice crop also seriously affected, India is expected to import wheat this year instead of exporting it. In an average year before the World War, India exported over 50,000,000 bushels of wheat.

In Canada the total yield of spring wheat is estimated at 273,020,000 bushels, of which 264,137,000 bushels were grown in Saskatchewan, Manitoba, and Alberta. Fall wheat, grown almost exclusively in Ontario and Alberta, was estimated at 15,473,000 bushels. The total wheat yield of Canada for 1921 is therefore 288,493,000 bushels, compared with 263,189,000 bushels last year.

A very unsatisfactory feature in the present international situation is the hopeless condition of the Russian crops. Unofficial reports state that during last autumn and the spring of this year only a very small area was sown to the various crops, resulting in a failure to produce sufficient food for the country's needs. It is also reported unofficially that a considerable amount of wheat will yet be imported by Russia this year. But up to the present time the amount of wheat, as well as other foodstuffs, which will be imported is conjectural, and the Bureau of Markets and Crop Estimates is unable to make a definite statement concerning it.

In northern Africa, the wheat crop was generally larger than last year. In Algeria, thrashing results show a better yield than was expected earlier in the season. In Tunis, bad weather reduced the yields somewhat from those expected earlier, while in Morocco the crop was generally reported as satisfactory. According to estimates published by the International Institute of Agriculture at Rome, these three countries are expected to produce, for 1921, a yield of 66,138,000 bushels of wheat, compared with 36,743,000 bushels in 1920.

AN ENGLISH VIEW OF AMERICAN BIOLOGY

At a recent meeting of the National Union of Scientific Workers in the Royal School of Mines, London, Sir Daniel Hall took the chair, and a lecture was given by Mr. W. B. Brierley head of the department of mycology at Rothamsted on "Personal Impressions of American Biological Research."

According to *Science Progress* Mr. Brierley opened by explaining that his visit to America was made primarily to attend the Phyto-

pathological Conference, which was peripatetic, ending at Lancaster, Ohio. By means of a sketch-map Mr. Brierley showed a complicated personal itinerary, from Quebec as a point of arrival, reaching to the southern limits of the United States, and including all the principal universities and biological stations. He then indicated the most striking and individual feature of American agriculture, which he described as the main source of wealth of the country. This was the almost complete concentration in wide areas of a single crop, so that there were 500 miles together of maize, of cotton, or of rice, and not much smaller areas of fruit or vegetables for preserving. One consequence of this was that plant disease ran riot through a whole area, and the field problems confronting the American agricultural biologist were so vast and menacing as almost to destroy the possibility of academic research, except in the eastern industrial regions, and to force the whole available scientific personnel into the field to stem a tide of disaster. In the industrial area, containing the older universities, the biological work approximated closely to that done in this country in subject and mode of attack, but in the state universities in the newer agricultural regions—each with its own single crop presenting urgent problems for solution—certain feaures were noticeable: (1) An early and extreme specialization, subjects which were here studied after a degree course in botany (such as plant pathology), being themselves degree courses, and the graduates, almost all of whom, from economic pressure on individuals and the crying need in the field, were unable to take post-graduate training, immediately devoting themselves exclusively to the study of a single type of disease. (2) There was almost no gradation between the academic biologist of real eminence and national or international reputation and the ordinary worker dealing with a limited field of applied science. For this reason the science on which their specialized practise was founded was apt to be too much in the background. Coming back, he felt Europe and England to be somewhat old, sophisticated, and contemptuous of youth. America is young, and has all the boundless energy of adolescence and its unique fervor.

Sir D. Hall, before opening the discussion, pointed out that America was not a country of farmers, but of industrialists working upon the land. Consequently they were less tied by tradition, and more ready to look to science for help. On the other hand, the state legislatures, which supported the biological work, were very apt to demand immediate results, and some promising work was spoiled by premature publication. England should take warning of the danger of allowing the legislature to get direct control of scientific research. He wecomed such a visit as Mr. Brierley's as a help towards counteracting the tendency in all civilized countries to erect quarantine walls against the entry of plants from abroad, for fear of disease. This fear was easily exploited by commercial firms for their own ends. The only way to get over the difficulty was to establish such mutual confidence between biologists in different countries as to render a guarantee of health given by the experts in any country absolutely trustworthy.

THE RETIREMENT OF DR. W. H. JORDAN

The faculty of Cornell University has adopted the following resolutions:

On the occasion of the retirement of Dr. Whitman Howard Jordan from the professorship of animal nutrition in Cornell University and from the directorship of the New York Agricultural Experiment Station at Geneva, the members of this faculty desire to record their appreciation of the inestimable service which Professor Jordan has rendered to science and to the scientific agriculture of the state and of the nation.

Professor Jordan assumed the directorship of the experiment station in 1896, a critical time for agriculture and for the new experiment stations. He brought to his work true scientific training, gained as an undergraduate student at the University of Maine, as a postgraduate student at Cornell University under the guidance of Professor Caldwell, and as an assistant to Dr. Atwater at the Connecticut Agricultural Experiment Station; and long experience as a teacher of agriculture and agricultural chemistry at the University of Maine

and at the Pennsylvania State College, and as director of the Maine Agricultural Experiment Station. With this wealth of training and experience, in addition to his high scientific ideals, his indomitable courage, his unflagging zeal for truth, his sound judgment in the selection of associates, and his unswerving loyalty to the best interests of agriculture, he has made a profound and lasting impression on the agriculture of this state.

The outstanding feature of his long service in the interest of agriculture has been his strict adherence to the dictates of science without regard to popular esteem or favor. Strong as the temptation has been for an administrator to popularize the work of his institution at the expense of its research, Professor Jordan, in his administration of the station, has held strictly to the original purpose and object of the institution uninfluenced by considerations of popular favor. Under his wise and capable administration, the New York Agricultural Experiment Station has attained a leading position among the agricultural experiment stations of the world.

Professor Jordan's connection with this college as professor of animal nutrition dates only from June 22, 1920, but his interest in the institution and his hearty and cordial cooperation have extended through all the twenty-five years that he has been director of the experiment station at Geneva. Accordingly there has always existed between these two institutions such close and gratifying cooperation in the prosecution of investigation and research that their work has ever been supplementary and unnecessary duplication of effort has been avoided.

In spite of all the multiplicity of duties which naturally come to an outstanding figure in agriculture, Professor Jordan has always found time to continue his own scholarly work in animal nutrition and to advise critically with members of his staff on a wide variety of highly technical subjects. His keenly analytical mind, his sound judgment, his unusual administrative ability, and, above all, his lofty personal ideals and breadth of vision, have endeared him to his colleagues and associates. He has richly earned the relief which retirement from active service brings, and we, his colleagues, wish him many years in which to enjoy the privileges of the contemplative life which is now his.

SCIENTIFIC NOTES AND NEWS

AT the recent Montreal meeting of the Society of Chemical Industry, Dr. Robert F. Ruttan, MacDonald professor of chemistry at McGill University, was elected president in succession to Sir William Pope.

THE University of Edinburgh has conferred the degree of doctor of laws on Dr. Irving Langmuir, of the research laboratory of the General Electric Company, Schenectady, who at the meeting of the British Association in that city opened the discussion on "The Structure of Molecules."

PROFESSOR EDWARD W. BERRY, of the Johns Hopkins University, has been elected a fellow of the American Academy of Arts and Sciences.

DR. JAMES M. ANDERS has been elected president of the American Therapeutic Society for the ensuing year. Dr. Anders was also recently elected president of the American College of Physicans.

BARON R. VON HÜGEL has resigned the curatorship of the Museum of Archeology and Ethnology of the University of Cambridge and Dr. A. C. Haddon, Christ's College, has been appointed deputy curator.

THOMAS FORSYTH HUNT, dean of the college of agriculture, University of California, has resumed his office after a year's stay in Europe, spent in part at Rome as the delegate of the United States to the International Institute of Agriculture.

HARRY D. KITSON, professor of psychology at Indiana University, has returned from Europe where he conferred with investigators in industrial psychology in England, France, Germany and Switzerland.

PROFESSOR WILLIAM S. COOPER, of the University of Minnesota, is making a study of the recession of the Muir Glacier at Glacier Bay, Alaska.

MR. MONTAGUE FREE, horticulturist and head gardener of the Brooklyn Botanic Garden, returned recently from England where he visited Kew and various other public and private gardens. In the course of the trip,

Mr. Free secured many valuable seeds and living plants in exchange for similar material from the Brooklyn Botanic Garden.

We learn from *Nature* that Mr. B. A. Keen, head of the soil physics department, Rothamsted Experimental Station, has been awarded a traveling fellowship by the Ministry of Agriculture. He has come to America to inspect general agricultural conditions with special reference to problems on soil cultivation.

Dr. Ma Saw Sa, head of the Lady Dufferin Hospital, Rangoon, Burma, has come to the United States to continue the study of medicine at Johns Hopkins University, Baltimore.

A statue of Dr. Enrique Nuñez has been erected at the entrance to the grounds of the Garcia Hospital at Havana, the construction of which was due to his initiative. He was long chief of the national public health service.

An oil portrait of the late Senator Judson H. Morrill, which for many years hung in his Washington home, has been presented to the University of Vermont, and has been placed in Morrill Hall.

The Experiment Station Record announces the death on July 5, at the age of seventy-eight years, of John Hamilton, formerly professor of agriculture in the Pennsylvania State College, and of Jacob H. Arnold, agriculturist in the Office of Farm Management and Farm Economics, of the U. S. Department of Agriculture, who died on July 12, at the age of fifty-seven years.

Professor Henri Beaunis, known for his work on physiological psychology and hypnotism at Mercy and later at Paris, has died at the age of ninety-one years.

The 1921 volume of the Summarized Proceedings of the American Association for the Advancement of Science, the publication of which has been greatly delayed owing to the printers' strike, will soon be issued from the office of the permanent secretary of the association. This volume contains the old and the new constitution, the lists of officers, and references to Science for the reports of the Pacific Coast meeting (summer of 1915), the Columbus meeting (1916), the New York meeting (1917), the Pittsburgh meeting (1918), the Baltimore meeting (1919), the St. Louis meeting (1920), and the Chicago meeting (1921). It also contains the complete list of members of the association, corrected to June 15, 1921. Members who have already ordered the volume will be sent copies as soon as the book is published; and those who have not ordered the volume may still do so, the price being two dollars, payable when the order is placed. The price to others is two dollars and fifty cents. The new list constitutes a directory containing the names, degrees, positions, addresses, etc., of about 12,000 scientific workers and others interested in scientific progress. It has been prepared from data obtained through special information blanks sent to all members.

The Société de Chimie Industrielle will hold a congress in Paris in October. There will be thirty-four sections representing the various applications of chemistry and some valuable discussions are anticipated. A reception of the members will take place on the evening of October 9, and the opening meeting will be held on the following day, under the presidency of Monsieur Dior, Minister of Commerce. On October 11 the Minister of Agriculture will occupy the chair at a banquet in the Palais d'Orsay. A number of works will be visited and an exhibition is being organized in connection with the congress.

The board of trustees of The Ohio State University has authorized the establishment, within the college of agriculture, of the plant institute of the Ohio State University. All members of the staff of the college interested in plant studies may be members, and all graduate students doing their major work with plants are associate members. The institute will conduct a seminary, review the work of its graduate students and encourage research, especially the study of such problems as require cooperation. The departments of the college chiefly concerned are: Botany, Horticulture, Farm Crops, Agricultural Chemistry and Soils.

THE Connecticut legislature has increased the biennial appropriation for the State Experiment Station from $45,000 to $82,000. It has also appropriated $10,000 for investigations on matters connected with the production of tobacco. The station has secured a field of about 13 acres where experimental work may be carried on along this line.

ACCORDING to the *Journal* of the American Medical Association a new hospital group, designed to be one of the largest and most up to date in the country and incorporating the University Hospital, the nurses' home and the schools of medicine, dentistry and pharmacy in a single system, is to be erected by the University of Maryland at Lombard and Green streets, Baltimore. The main building will be eleven stories in height with a roof garden above. Plans call for a hospital of 300 beds, and ultimate expansion to 500 is contemplated. The nurses' home is planned to furnish accommodations for 200, with facilities for 300 students in the combined schools. The cost is estimated at about $1,250,000. When the project is fully developed, a unique feature will be an arrangement by which the most modern adjuncts of medical science will be placed at the disposal of rural practitioners through graduate and extension courses. It is planned to have traveling instructors, who will hold courses in rural communities and also to give the rural practitioner the opportunity to bring all special cases to the hospital. The institution will offer the medical practitioner the service which the agricultural college of the university now provides for the farmer. One of the principal objects of the enlarged institution will be to relieve the city's inadequate hospital facilities. Construction of the first portion of the group will be begun within the month and will cost approximately $250,000 when completed; erection of the second unit of the home is expected in about a year. The whole project will require several years for its development. The University Hospital was opened in 1823 under the name of the Baltimore Infirmary, and has been enlarged fourfold by successive additions.

THE San Diego museum has been presented with a library of ancient and modern manuscripts and books treating Chinese art, by Dr. William P. Gates, one of the founders of the institution.

Nature states that in consequence of the retirement of Sir Hercules Read, the department of the British Museum hitherto known as the Department of British and Medieval Antiquities and Ethnography has been divided, and the following appointments have been made by the principal trustees: Mr. O. M. Dalton to be keeper of the Department of British and Medieval Antiquities; Mr. R. I. Hobson to be keeper of the Department of Ceramics and Ethnography; Mr. T. A. Joyce to be deputy-keeper in the Department of Ceramics and Ethnography. Mr. Reginald Smith, hitherto deputy-keeper in the undivided department, becomes deputy-keeper in the Department of British and Medieval Antiquities. The prehistoric collections fall into the Department of British and Medieval Antiquities, and the Oriental collections into that of Ceramics and Ethnography.

UNIVERSITY AND EDUCATIONAL NEWS

TRINITY COLLEGE will receive a contribution of $125,000 to its centennial fund from the General Education Board.

THE *Experiment Station Record* reports that a fund to be known as the A. D. Watson prize fund is being collected by subscription at the University of Minnesota in honor of the retiring director of extension work. The income of this fund is to be used annually in either the college or school of agriculture or both as prizes to students excelling in studies having to do with cooperation and cooperative enterprises.

AT the recent meeting of the State Board of Agriculture, the resignation of Dr. F. S. Kedzie as president of the Michigan Agricultural College, effective on August 31, was accepted, and he was appointed dean of the Division of Applied Sciences. Professor David Friday of the department of economics of the University of Michigan was appointed

president, effective on January 1, 1922. R. S. Shaw, dean of the Division of Agriculture, was appointed acting president for the interim.

D. T. Gray, chief in animal industry in the North Carolina Agricultural College and station, has been appointed director of the Alabama station, succeeding J. F. Duggar, director since 1903, who retires to become consulting agriculturist.

Dr. Olof Larsell, former associate professor at Northwestern University Medical School, Chicago, has been appointed professor of anatomy at the University of Oregon Medical School.

Dr. J. P. Baumberger has been promoted to an assistant professorship of physiology at Stanford University.

Dr. F. C. Vilbrandt, of the Ohio State University, has been appointed associate professor of industrial chemistry of the University of North Carolina.

DISCUSSION AND CORRESPONDENCE

DISCOVERY OF SAUROPOD DINOSAUR REMAINS IN THE UPPER CRETACEOUS OF NEW MEXICO

In a small collection of vertebrate fossils recently received at the U. S. National Museum, from Mr. John B. Reeside, Jr., geologist of the U. S. Geological Survey, was an almost complete left scapula of a large Sauropodous dinosaur. The importance of this particular specimen lies in the fact that it was collected by Mr. Reeside in the Ojo Alamo formation, Upper Cretaceous, as developed in the San Juan Basin in northern New Mexico. Since the remains of Sauropodous dinosaurs have not been known before above the early Lower Cretaceous in North America, the extension of their geological range into the Upper Cretaceous, as indicated by the present discovery, is of the greatest interest.

The close general resemblance of this bone to the described scapulæ of the Sauropoda from Morrison formation, its great size (five feet in length), and the fairly good state of preservation, precludes the possibility of mistaken identification, and the determination of its geological occurrence by a geologist of the acknowledged ability of Mr. Reeside, who has an intimate acquaintance with the geological structures and succession of formations in the San Juan Basin, due to two field seasons spent in the area, places the determination of the geological position of the specimen beyond all question of doubt.

This preliminary announcement will be followed by a more detailed account of the specimen when its preparation now in progress is completed.

Charles W. Gilmore

U. S. National Museum,
August 16, 1921

LEAF STRIPE DISEASE OF SUGAR CANE IN THE PHILIPPINES

In early 1920, a firm of Japanese sugar-cane growers introduced cane points of Formosan cane varieties for use on their plantation in Rizal Province, Luzon. The sugar-cane points, according to the Japanese firm, had been grown by the Experiment Station of the Japanese Government in Formosa. On arrival at the port of Manila, the shipment was intercepted by the Philippine plant quarantine inspectors, but the Japanese growers prevailed upon the too-lenient government official to allow them to bring in the cane, after dipping it in Bordeaux mixture.

Upon the appointment of the writers to the plant disease laboratories in March, 1920, they became cognizant of these circumstances, and since then, periodical inspections of the planting have been made. In April, 1921, the cane having been ratooned numerous cases of etiolation of the young plants were observed. Such light-colored plants were very conspicuous and could be observed at a considerable distance from the field.

On the lower surface of affected leaves, a white spore mass was abundant; the pathological condition was of course immediately suggestive of downy mildew of the sugar cane. Examination of the fungus evidenced the presence of a *Sclerospora* species. This pathological condition could not be found on

fields of native cane adjacent to, and surrounding, the field of Formosan cane. According to Dr. W. H. Weston,[1] the morphology of *Sclerospora philippinensis* is very nearly identical to that of *S. sacchari*. However, he states:

> In the Philippines, in regions heavily infected with the maize mildew, sugar cane fields comprising many varieties grown under widely varying conditions and situated adjacent to the badly infected maize, and even containing some maize plants growing among and in contact with the young cane, have been under frequent observation during all stages of their development for over a year, and yet no case of infection with the downy mildew of maize has ever been seen.

He was, moreover, unable to cross-inoculate *S. philippinensis* from corn to sugar cane. The evidence is therefore strongly suggestive of the importation of the sugar-cane downy mildew, *Sclerospora sacchari* T. Miyaki, from Formosa.

The only literature on this disease which we have available here is the above-mentioned publication by Dr. Weston on the Philippine corn mildew, which incidentally discusses the cane mildew.

Measures have been taken to plow up the affected field, burn the affected stubble, and fallow the land. Steps to trace seed cane that emanated from the field are also under way, and it is possible that the disease may be entirely eradicated in the Philippines. The present brief note is presented as of possible interest to agronomists and plant quarantine officials of western countries. The importation of this disease and the recent experience in the Philippines with the introduction of Fiji disease of cane are two excellent examples of the need for rigid enforcement of plant quarantine regulations.

H. ATHERTON LEE,
MARIANO G. MEDALLA

PLANT DISEASE LABORATORIES,
BUREAU OF SCIENCE AND
BUREAU OF AGRICULTURE,
MANILA

[1] Weston, W. H., "Philippine downy mildew of maize," *Jour. Agr. Res.*, XIV., No. 3, p. 97.

ENGLISH PRONUNCIATION FOR THE METRIC SYSTEM

TO THE EDITOR OF SCIENCE: May I add a word of approval to what Dr. Frost has said in *re* (SCIENCE, May 13, 1921) "English Pronunciation for the Metric System" and suggest that the word ki'lo-me'ter should be pronounced with the accent upon the first and third syllables. In some quarters it is pronounced kilo'm-eter, contrary to the more general usage. This pronunciation, however, follows the custom in the case of thermo'meter, which is a much older word.

THADDEUS L. BOLTON

THE TEMPLE UNIVERSITY,
PHILADELPHIA

GREGOR MENDEL AND THE SUPPORT OF SCIENTIFIC WORK AT BRUNN

TO THE EDITOR OF SCIENCE: Under date of December 29, 1920, I received a letter from Dr. Hugo Iltis of Brünn, Czechoslovakia, of which the following paragraphs are extracts:

> The venerable old "Naturforschende Verein" of Brünn runs the risk of stopping scientific work for want of money. For the same reason our university extension work is cut short. In this condition of utter distress I apply to your kindness and ask you to help us. Wealthy friends of Mendelism could perhaps be induced to grant us the means to continue our scientific and popular education-work. If it would be possible to get an assistance of one thousand dollars for each of the two institutions, the "Naturforschende Verein," where Mendelism took its origin, and "University Extension of Brünn," where work has just begun, would be saved for the next two or three years.
>
> When we published the Mendel-festival-volume, science and art flourished, and we tried by our work to prove worthy of Gregor Mendel. Now we have become so poor that we can not buy any scientific literature, nor can we have scientific treatises printed. We have made up our minds to sell our most precious treasure, the original manuscript of Gregor Mendel's most renowned work, "Versuche über Pflanzenhybriden," and I ask you to lend us your kind assistance in this matter too. Perhaps it could be sold by auc-

tion with the lowest bid of $6,000. This sum would afford us the chance of buying a small house as a refuge for our collections and library, which are in constant danger of being burned out.

It seems to me that all who appreciate the importance of Mendel's contribution should be actively interested in this message. Just what can and should be done and how to go about it are matters for discussion. I would suggest that those interested express their views in the columns of SCIENCE. However, some may wish to communicate directly with Dr. Iltis. His local address is Bäckergasse 10, Brünn, Tschechoslwakei.

E. B. BABCOCK

NOTES ON METEOROLOGY AND CLIMATOLOGY

DETERMINING THE TRUE MEAN TEMPERATURE

WHAT is the true mean temperature? It is a much easier task to define the true mean temperature than to determine it, but the prosecution of meteorological and climatological work demands that this element be determined. A very detailed and thorough discussion of the question has been published by Mr. C. E. P. Brooks, of the British Meteorological Office, in the *Monthly Weather Review*,[1] and it is of interest to review the varied nature of the problem and the solutions offered.

The "true mean temperature" is the mean height of a thermograph trace corrected for any sources of instrumental error. In practise, however, the mean of twenty-four hourly observations, or even the mean of observations every two, three, or four hours, is sufficiently close to yield the daily mean temperature. But it is not always feasible to secure such frequent observations, and the problem of reconstructing the true mean from three observations daily and the maximum and minimum faces the meteorologist. There are four ways of accomplishing this:

First, the combination of the means of the three daily observations at fixed hours, or the maximum and minimum, in proportions that have been found to be satisfactory at certain standard stations. If observations at 7 A.M., 1 or 2 P.M., and 9 P.M. be designated by *I, II,* and *III,* respectively, and the true mean by *T,* it is found that

$$T = (I + II + 2 \times III)/4$$

gives the best results, in general; but, in Greenland, where the morning observation occurs at 8 A.M., the formula commonly used is

$$T = [2(I + II) + 5 \times III]/9.$$

The author carried out an investigation of this type of formula by the method of least squares, for various groups of stations, such as western Europe, subtropics, and tropics, and found that for the first the usual one (given above) gave the best results; for the subtropics, the best combination is

$$T = [I + II + III - \tfrac{1}{10}(II - III)]/3;$$

and for the tropics, this last can be used, although it is not as accurate for the tropics as for the subtropics. An alternative formula which gave very satisfactory results for Batavia is

$$T = [2(I + II) + 3 \times III]/7.$$

These apply, of course, to the hours specified above. It is further pointed out that the maximum and minimum can be combined into such formulæ, instead of the three observations, and examples are given for Hamburg, in which the maximum and minimum are combined with the morning and evening observations; and for Tunis and Egyptian stations in which the minimum only was combined with the three daily observations.

Second, "the calculation of appropriate additive corrections for various combinations of hours or for the mean of the maximum and minimum at standard stations, and their transference without modification to other stations in the vicinity." This method is only applicable to those stations or regions where the conditions are similar, such as are to be found in Russia and Siberia, or in the eastern half of the United States. The method is to plot the corrections for standard stations and to read off for the intermediate stations the appropriate correction. In mountainous districts, such as western United States, or the mountains of India, this scheme is unsatis-

[1] April, 1921, pp. 226–229.

factory. A combination of this method with the first one above is often helpful, and has been used in Chile.

Third, "the corrections at the standard station may be multiplied by a factor proportional to the daily range (or to the difference between midday and evening observations) at the station to be corrected." This method depends upon properly correcting for any difference in daily range which may exist between nearby stations, as, for instance, between hill and valley stations where the daily ranges may be quite different. But care must be used to see that the climates of the two places are similar, for the daily amplitude of variation may be the same, but the shape of the curve different. This was found to be the case in applying the method to Los Andes (valley) and Santiago (coastal slope), Chile, in which the amplitude is the same but the sharp night minimum at Los Andes was markedly different from that at Santiago.

The fourth, and last, method is that in which "all direct use of standard stations may be avoided and the reduction to true mean based on considerations connected with the general phenomena of the diurnal variation of temperature." This makes no use of standard stations but bases the whole system upon a normal diurnal curve which may be expressed by the Fourier series

$T_h = T + a_1 \sin (t_h + A_1) + a_2 \sin (2t_h + A_2)$, in which the coefficients of the first and second harmonics may be calculated as follows:

$$a_1 = -0.72 + 0.44 \ (M - m),$$
$$a_2 = +0.54 + 0.08 \ (M - m).$$

This method has been thoroughly tested and has given satisfactory results, but is chiefly valuable when the stations are so situated that the other methods are not applicable.

A. Buchan favored the mean of the daily maximum and minimum as the most satisfactory expression of true mean temperature, and the view has become widely accepted. But there are objections, not only from the instrumental standpoint—for maximum and minimum thermometers are more likely to develop systematic errors than are dry-bulb thermometers—but also because the ratio of this mean to the true mean is dependent upon location, time of year, and cloudiness. For that reason, the author advises meteorologists in English-speaking countries to make less use of the mean of the daily extremes and more of suitable combinations of the observations at fixed hours, such as the first formula above.

C. LeRoy Meisinger

Washington, D. C.

SPECIAL ARTICLES

ON THE ELIMINATION OF THE X-CHROMOSOME FROM THE EGG OF DROSOPHILA MELANOGASTER BY X-RAYS

Some of the results of the investigation of the biological effects of X-rays point to a specific effect of the rays on the nuclear matter of the dividing cell and especialy the germ cell.

1. Actively growing tissue whether normal or pathological is the most susceptible to X-rays.

2. It has been found comparatively easy to sterilize a number of different species without apparently otherwise injuring them.

3. Perthes[1] has found that X-rays have a destructive effect on chromosomes in the ova of *Ascaris megalcephala.*

The experiments to be described were performed with a view to determining if X-rays by affecting the X-chromosome could disturb the inheritance of a sex-linked character. Wild type (red-eyed) females of *Drosophila melanogaster,* homozygous for red-eye, were X-rayed soon after emerging from the pupa with a dose just under the sterilization dose and mated to white-eyed males. Sisters of the rayed females were used as controls and mated to white-eyed males. The white eye color is sex-linked and recessive to the red and when there is no non-disjunction the offspring in tht first generation of a cross between a homozygous red-eyed female and a white-eyed male are all red-eyed.

In all, four experiments have been performed. In three of these, numbers 71, 76, and 77, thirty-five virgin females, homozygous for

[1] Perthes, *Deut. Med. Woch.,* 30, 1904.

the red-eyed character, were mated with white-eyed males. Nineteen of these were used as controls and sixteen were X-rayed soon after emerging from the pupa and immediately before mating. The rayed females were the sisters of the controls. *None of the nineteen control pairs produced white-eyed males.* One of the rayed females was sterile. *Of the fifteen fertile rayed females, twelve produced one or more white-eyed males.* The total number of offspring in the first generation produced by the control pairs was 6579 (3367 ♂, 3212 ♀) all red-eyed, and by the pairs in which the females were rayed it was 2460 (1227 red-eyed ♂, 1211 red-eyed ♀, 20 white-eyed ♂ and 2 gynandromorphs). In the fourth experiment seven wild-type sister females were used, three were kept as controls and four were rayed. All were mated with white-eyed males. One of the control females produced one white-eyed male. Two of the three rayed females produced white-eyed males, one producing three and the other one.

In the first and fourth experiments the white-eyed males were also homozygous for the character, "dumpy," which is located in the second chromosome. Of the six white-eyed males produced in these experiments five had normal wings and the other died before its wings expanded.

Twenty-three out of the twenty-four exceptional white-eyed males came from eggs which were laid during the first six days after raying and mating. The other male came from an egg probably laid on the seventh day after raying. Further the exceptional white-eyed males divide themselves into two groups corresponding to eggs laid during the earlier part and the later part of this six day period.

That the presence of these white-eyed males could be due to natural non-disjunction and not to any effect of the X-rays seems extremely unlikely from the following considerations: In experiment 71, out of 7 fertile sisters the two which were X-rayed produced white-eyed males. The chance in a random picking of getting a particular two out of seven can be shown to be 1 in 42. We may add the results of experiments 76 and 77 since the females used in these experiments were all the offspring taken at random of two pairs. If the result here was not due to X-rays, then in taking at random 12 females from 26 for raying we must have taken the only 10 which produced white-eyed flies. The chance of doing this can be shown to be 1 in 9,600,000 tries.

Since the white-eyed males produced by the X-rayed females when crossed to white-eyed dumpy males were normal winged, the second chromosome of the female can not have been affected to the extent of the elimination of the gene for normal wing.

It may be stated that a repetition of these experiments is in progress and that a number of experiments have already been carried far enough to confirm the earlier findings.

In order to determine whether the whole or a part of the X-chromosome is affected by the X-rays, two strains with sex-linked characters have been used, both obtained through the kindness of H. H. Plough—an eosin-miniature stock and a scute-echinus-cut-vermilion-garnet-forked stock. Males of both of these stocks have been used in experiments similar to those described. In all cases so far the exceptional males produced by the X-rayed females (the control females have produced no exceptional males) have all the sex-linked characters.

Since the eggs which have produced the exceptional white-eyed males were probably rayed either 2 to 3 or 5 to 7 days before laying, there seems reason to believe that they were acted on by the X-rays while preparing for one of the maturation divisions. (Compare here the work of H. H. Plough, 1917, on the effect of temperature on crossing over.)

We know from the work of Stevens[2] and Metz[3] that the X-chromosomes of *Drosophila melanogaster* (*ampelophila*) behave, in the male, differently from the other chromosomes in the maturation divisions. If, as seems probable, the chromosomes during division go through a stage in which they are particularly susceptible to X-rays, then it would seem

[2] Stevens, *Proc. VII. International Zool. Cong.*, 1907.

[3] Metz, *Journ. Exp. Zool.*, 1914.

probable that the X-chromosomes may pass through that stage at a time different from that at which the other chromosomes pass. This would account for the production of the exceptional white-eyed males in the experiments if we consider that the X-rays were applied to the particular germ cell at a time when only the X-chromosome was in a condition suceptible to the dose given.

The writer wishes to express his great indebtedness to Dr. Willis R. Whitney, director of the Research Laboratory of the General Electric Company at whose suggestion work on fruit-flies was undertaken and without whose cooperation it could hardly have been done. He is also indebted to Mr. O. J. Irish for accurate and careful work as technical assistant throughout the investigation.

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EPIDEMIC PNEUMONIA IN REPTILES

DURING the spring and early summer months of 1919 there occurred an epidemic among the reptiles kept in captivity in the Bronx Zoological Gardens which resulted in the death of many of them.

The clinical course of this disease, if it may be considered the same disease in all, was difficult to follow on account of the well-known sluggishness of these animals, which often remain quiet for a long time and fail to eat anything. For this reason the attention of the caretakers was seldom attracted to sick animals until they were found dead. In some cases, however, it was observed that they suffered from an intense dyspnœa and held their mouths open in the effort to breathe. Others emitted a frothy, slimy exudate from the mouth and nostrils. Even then it was difficult to observe any other symptoms and the attempt to secure a series of observations on the temperature of the sick animals for comparison with that of several normal ones of the same sort could not be carried out successfully.

A great number of those which died were sent to the laboratory for autopsy and it is interesting that several turtles sent from the New York Aquarium were found to have died from the same disease. Careful autopsies were made upon all these animals and cultures and smears taken from the lungs and upper respiratory tract and usually also from the heart's blood. Other snakes and some rabbits, rats and mice were inoculated with the cultures derived from these cases.

Cases of pneumonia were studied at autopsy in the following animals, often in many individuals of the same species: *Iguana tuberculata, Zamenis lamelliformis* (Texas rattlesnake), *Trachyurus rugosus* (stump-tailed lizard), *Crotalus atrox* (Florida rattlesnake), *Ancistrodon contortrix* (copperhead), *Varanus gouldi* (Australian monitor), *Spilotes corais* (blacksnake), *Tupinambis teguexin* (yellow tegu), *Pityophis sayi* (bull snake), *Alligator mississippiensis, Anaconda, Chelonia imbricata* (hawksbill turtle), *Eutænia sirtalis* (garter snake), *Coluber guttatus, Thalassochelys caretta* (loggerhead turtle), *Heloderma suspectum* (gila monster), *Ophibolus getulus* (king snake), *Chrysemys elegans* (Cumberland turtle), *Chrysemys picta* (painted turtle), *Tropidonotus fasciatus* (water snake), *Heterodon platyrrhinus,* and *Zamenis flagelliformis.*

The autopsies on these animals as a rule revealed a partial consolidation of the tubular spongy lung, various diverticula of the main bronchial cavity with their air cells being filled with an opaque blood-stained grayish exudate with occasional hæmorrhages in the surrounding tissue. In one instance (*Varanus*) there was also an acute pericarditis with yellowish effusion upon the surface of the heart.

Smears from the consolidated portions of such lungs showed the presence of great numbers of rather small gram negative bacilli, sometimes with a slight admixture of gram positive diplococcoid organisms but usually in practically pure culture.

Microscopically, the condition was fairly uniform in all. In *Crotalus atrox* many of the wide air cells were distended with compact masses of cellular exudate composed chiefly of leucocytes which are large with round vesic-

ular nucleus and indefinite granules. There were many red corpuscles and more especially nuclei of laked red corpuscles mingled with these, but little fibrin. In this exudate and especially in the crevices between masses of exudate great clouds of gram negative bacilli could be seen. The same description applies to the lungs of *Ancistrodon, Zamenis, Pityophis, Chelonia imbricata,* et cetera.

The lungs of the anacondas presented a slightly different appearance, for the gram negative bacilli tend to be collected in masses in the alveoli and densely surrounded by leucocytes and red corpuscles in a disintegrated condition so as to form round balls. The large leucocytes are filled with conspicuous granules which stain purple with the Gram stain and with Wright's stain and are probably to be regarded as basophilic granules.

So, too, the lungs of *Tupinambis teguexin* showed round nodules or masses of cells clustered round a central clump of gram negative bacilli.

In the lungs of *Heloderma* the exudate in the alveoli was composed of a dense pink staining granular coagulated material with abundant clumps of gram negative bacilli usually enclosed in phagocytes.

The lung of *Chrysemys picta* presented a dense exudate of closely packed leucocytes with nuclei of red corpuscles and with great numbers of diffusely scattered gram negative bacilli. In this case the alveolar walls were much thickened and infiltrated with fluid and with leucocytes.

No especial alteration of the bronchial walls nor of the coarser supporting tissue of the lungs could be observed. The abdominal organs were in all cases apparently normal, and as a rule the animals were in a good state of nutrition.

Cultures made from heart's blood and lungs gave in practically every case luxuriant growths of a small gram negative bacillus when incubated at 23° C. Only in the case of *Thalassochelys Caretta* and one alligator were the bacilli somewhat larger.

Five of these strains were grown in broths containing various sugars for comparison with results shown in the following table.

Growth produced sediment in all tubes except those with maltose inoculated with 2 and 4 where there was pellicle formation.

From the above table it will be seen that Nos. 1 and 3 agree in acid and gas formation when grown in the specified sugars, while 2, 4 and 5 differ among themselves and also differ from 1 and 3 in their powers of sugar fermentation and gas formation. When grown on gelatin liquefaction was produced by 4 and 5 but not by 1, 2 and 3. 4 also produced gas.

From several normal garter snakes studied as controls the cultures of heart's blood and lungs were sterile except in two cases in which occasional colonies of a quite different thick gram negative bacillus were found.

A rabbit was immunized with four injections of culture 4, and eight days after the last injection the serum of this rabbit agglutinated the homologous strain completely in a dilution of 1–60 but showed no agglutination with nine other strains.

Intratracheal injections of cultures 4 and 6 were made in garter snakes and two species of *Chrysemys* and were followed by pneumonia exactly resembling that in the animals from which the cultures were taken. The

	Maltose		Levulose		Dextrose		Xylose		Saccharose		Lactose		Mannit	
	Acid	Gas	Acid	Gas	Acid	Gas	Acid	Gas	Acid	Gas	Acid	Gas	Acid	Gas
1	++	+	++	+	++	+	++	+	0	0	0	0	++	++
2	++	0	++	0	++	0	0	0	++	0	0	0	++	0
3	++	+	++	+	++	+	++	+	0	0	0	0	++	+
4	0	0	++	0	++	0	0	0	0	0	0	0	++	0
5	++	+	++	+	++	+	++	+	++	+	0	+	++	+

organism was recovered in pure culture from the lungs of these inoculated animals. The bacillus is also highly virulent for rabbits, killing them often within twenty-four hours.

No exact identification of the organism or organisms concerned in this epidemic can be offered, although in general they are very closely related to the rabbit septicæmia group. The bacteriological studies, for which I am greatly indebted to Mrs. Julia T. Parker, were not carried to completion but they show that although the gram negative bacilli found in all the cases were morphologically identical, they differed somewhat in their fermentation reactions and did not, except in the case of the homologous strain, agglutinate with the one specific serum produced in a rabbit. The latter result may be because of an unfortunate choice of one aberrant strain for the production of the serum or it may be because the various strains occurred in different species of reptile.

Since this was a well-defined epidemic of pneumonia affecting a variety of reptiles it seems probable that the original infecting organism may have acquired slightly different biological characters in its growth in different species.

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THE OHIO ACADEMY OF SCIENCE

The thirty-first annual meeting of the Ohio Academy of Science was held at Western Reserve University and Case School of Applied Science, Cleveland, March 25 and 26, 1921, under the presidency of Mr. W. H. Alexander, of the United States Weather Bureau, Columbus. Fifty-nine members were registered as in attendance; forty-seven new members were elected.

An excursion, organized in connection with the meeting, was carried out by the Section for Geology on May 28, 29, and 30. The itinerary (Wilmington, Clarksville, Fort Ancient, Oregonia, Dayton) was planned for the study of the Richmond formations of southwestern Ohio. The party of fifteen geologists was under the guidance of Drs. August Foerste and W. H. Shideler.

The trustees reported a gift of two hundred and fifty dollars from Mr. Emerson McMillin, of New York City, in furtherance of the research work of the Academy.

The death of one member was reported: Mr. Thomas Piwonka, of Cleveland. Mr. Piwonka was born of Bohemian stock in New York City, September 10, 1854; he died May 9, 1920. His membership in the Academy began in 1893. The obituary notice, prepared by Professor J. E. Hyde, closes with these words: "His life work was law, but in spare moments he was a naturalist with particular interest in geology, botany and microscopy. His passing removes one more (very few are left!) of that generation of men interested in the natural history of their locality, with the collector's keen instinct, to which paleontology is profoundly indebted. With them is passing a phase of our culture."

Another of the older members of the academy, Professor G. Frederick Wright, of Oberlin, died on April 20, less than a month after the meeting. His name appears on the program; but he was too ill to be present, and the paper was read by another. He had been a member since 1892.

Officers were elected as follows: *President*, R. C. Osburn, Ohio State University; *Vice-presidents:* Zoology, J. E. Kindred, Western Reserve University; Botany, E. N. Transeau, Ohio State University; Geology, J. E. Hyde, Western Reserve University; Physics, W. G. Hormell, Ohio Wesleyan University; Medical Sciences, F. C. Waite, Western Reserve University; Psychology, Rudolph Pintner, Ohio State University (since removed to Teachers College, Columbia University); *Secretary*, E. L. Rice, Ohio Wesleyan University; *Treasurer*, A. E. Waller, Ohio State University.

The scientific program was as follows:

PRESIDENTIAL ADDRESS

Thunderstorms: especially those of Ohio: Mr. W. H. Alexander, U. S. Weather Bureau, Columbus.

PUBLIC LECTURES

Hookworm and human efficiency: Professor Charles A. Kofoid, University of California.

Scientific work at the Ohio Bureau of Juvenile Research: Dr. Henry H. Goddard, Ohio Bureau of Juvenile Research, Columbus.

PAPERS

The new Cleveland Museum of Natural History: Paul M. Rea.

The state park situation in Ohio: J. Ernest Carman.

Chronological view of men of science: J. A. Culler.

A peculiar case of stature inheritance: A. B. Plowman.
A differential sensitivity theory of time and space and its bearing on evolution: L. B. Walton.
The relation of the biologist to public health administration: A. B. Plowman.
The function of the striæ and the origin of bilateral symmetry in the euglenoids: L. B. Walton.
The geographical distribution of the genera of the Opalinidæ: Maynard M. Metcalf.
Hemiptera of the Adirondacks: Herbert Osborn.
Collecting in southern Florida: Herbert Osborn.
Some studies in Hessian fly emergence: T. H. Parks.
Notes on the habits and life history of Galeatus peckhami Ashm.: Carl J. Drake.
A new Ambrosia beetle: notes on the work of Xyloterinus politus Say: Carl J. Drake.
Phylogeny and distribution of the genus Libellula: Clarence H. Kennedy.
Aids in teaching elementary cytology: Z. P. Metcalf.
The cytology of the seaside earwig, Anisolabis: S. I. Kornhauser.
Copulation in Planaria maculata: R. A. Budington.
On the regulative capacity of the neural tube: H. L. Wieman.
The musculature of the head and throat of Chimæra ogilvyi: Mae Friedlander.
New models of the development of the heart in the chick: Bradley M. Patten.
Some features of the morphology of the kidney of Necturus: S. W. Chase.
Orientation in the cat: Francis H. Herrick.
Diet of a captive mole: E. L. Moseley.
Additions to the birds of Ohio: Lynds Jones.
Phagocytosis and clotting in the perivisceral fluid of Arbacia: J. E. Kindred.
Further observations as to the effect of thyroid substance on plant protoplasm: R. A. Budington.
The origin and development of the prairie in North America: H. C. Sampson.
The significance of native vegetation in crop production: A. E. Waller.
Energy relations of an acre of corn: E. N. Transeau.
Some energy relations of aquatic life and their significance: L. H. Tiffany.
Contributions to the genetics and cytology of parthenogenetic Taraxaca: Paul B. Sears.
Reversal of the sexual state in Japanese hop: J. H. Schaffner.
The occurrence and abundance of certain algæ in Lake Erie: Malcolm E. Stickney.
The census of flowering plants on certain small islands of Lake Erie: Malcolm E. Stickney.
Causes and consequences of the irregularities in the glacial border in the Ohio Valley: G. Frederick Wright.
Explorations in eastern Bolivia: K. F. Mather.
Some sub-surface rock channels filled with glacial material: J. Ernest Carman.
A fault-zone breccia in the Bass Island series: J. Ernest Carman.
A disconformable contact at the base of the Sylvania sandstone: J. Ernest Carman.
The Ordovician and Silurian seas of American arctic and subarctic regions and the relation of their faunas to contemporaneous seas of European areas: August Foerste.
Some coastal geology of southern Florida: G. F. Lamb.
An interpretation of some Ohio geology: G. F. Lamb.
Richmond Ostracoda of especial interest: W. H. Shideler.
Additions to our knowledge of the Arnheim: W. H. Shideler.
A Pliocene brackish water fauna near Alexander, La.: E. R. Smith.
A modification of Hobbs's method of teaching interpretation of geologic maps: E. R. Smith.
An embryonic volcano in Adams County, Ohio: Walter H. Bucher.
Local geology of Cleveland from an economic standpoint: Frank R. Van Horn.
The reopening and the end of the Linton (Ohio) Coal-measures fossil-amphibian locality: J. E. Hyde.
The fauna of the Berea Grit; a recurrent Bedford fauna, and its bearing on the age of the Bedford: J. E. Hyde.
Some psychology applied to Americanization: Garry C. Myers.
Scientific direction of childhood,—America's greatest social and political responsibility: Herman H. Young.
Reliability of survey methods in individual diagnosis: Florence Fitzgerald.
Limiting factors in human behavior: A. P. Weiss.
Waste of mental ability in our school system: Helen Marshall.
(*a*) *Some studies in progress in the Cleveland School of Education:* (*b*) *Some data on learning curves:* Garry C. Myers.
College men in the penitentiary: Carl Murchison.
A preliminary report on retroactive inhibition (with particular reference to two conditions): E. B. Skaggs.
The measurement of psychological effects of fatigue and low oxygen: F. C. Dockeray.
Discussion of the legal status of psychology in Ohio State: led by H. Austin Aikins.

DEMONSTRATIONS

Chromosomal complexes of Anisolabis: S. I. Kornhauser.
Geographic distribution maps of the Opalinidæ and their hosts: Maynard M. Metcalf.
New models of development of the heart in the chick: Bradley M. Patten.
Chart and data relating to an interesting case of stature inheritance: A. B. Plowman.
Multiple ova in Graafian follicles of cat: Edward L. Rice.
Sulphur dioxide injury to vegetation: A. E. Waller.
Illustrations of euglenoids: L. B. Walton.

Edward L. Rice,
Secretary

Delaware, Ohio

SCIENCE

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PROBLEMS OF PHYSICS[1]

My predecessor in office a year ago reminded you that the theoretical researches of Einstein and Weyl suggest that not merely the material universe but space itself is perhaps finite. As to the probabilities I do not wish to express an opinion; but the statement is significant of the extent of the revolution in the conceptions and fundamental principles of physics now in progress. That space need not be infinite has, I believe, long been recognized by geometricians, and appropriate geometries to meet its possible limitations have been devised by ingenious mathematicians. I doubt, however, whether these inventive gentlemen ever dreamed that their schemes held any objective validity such as would assist the astronomer and the physicist in understanding and classifying material phenomena. It is not certain that they will; but the possibility is definite. Apart from this, the whole development of relativity is an extraordinary triumph for pure mathematics. Had Einstein not found his entire calculus ready to hand, owing to the purely mathematical work of Christoffel, Riemann, and others, it seems certain that the development of generalized relativity would have been much slower. It is a pleasure to be able to acknowledge this indebtedness of physics and astronomy to pure mathematics.

Relativity is the revolutionary movement in physics which has caught the public eye, perhaps because it deals with familiar conceptions in a manner which for the most part is found pleasantly incomprehensible. But it is only one of a number of revolutionary changes of comparable magnitude. Among these we have to place the advent of the quan-

[1] Address of the President of Section A—Mathematics and Physics, British Association for the Advancement of Science, Edinburgh, September, 1921.

tum, the significance of which I hope we shall thoroughly discuss early next week. The various consequences of the electronic structure of matter are still unfolding themselves to us, and are increasing our insight into the most varied phenomena at a rate which must have appeared incredible only a few decades ago.

The enormous and far-reaching importance of the discoveries being made at Cambridge by Sir Ernest Rutherford can not be overemphasized. These epoch-making discoveries relate to the structure and properties of the nuclei of atoms. At the present time we have, I think, to accept it as a fact that the atoms consist of a positively charged nucleus of minute size, surrounded at a fairly respectful distance by the number of electrons requisite to maintain the structure electrically neutral. The nucleus contains all but about one two-thousandth part of the mass of the atom, and its electric charge is numerically equal to that of the negative electron multiplied by what is called the atomic number of the atom, the atomic number being the number which is obtained when the chemical elements are enumerated in the order of the atomic weights; thus, hydrogen = 1, helium = 2, lithium = 3, and so on. Consequently the number of external electrons in the atom is also equal to the atomic number. The evidence, derived from many distinct and dissimilar lines of inquiry, which makes it necessary to accept the foregoing statements as facts, will be familiar to members of this Section of the British Association, which has continually been in the forefront of contemporary advances in physical science. But I would remind you in passing that one of the important pieces of evidence was supplied by Professor Barkla's researches on the scattering of X-rays by light atoms.

The diameters of the nuclei of the atoms are comparable with one millionth of one millionth part of a centimeter, and the problem of finding what lies within the interior of such a structure seems at first sight almost hopeless. It is to this problem that Rutherford has addressed himself by the direct method of bombarding the nuclei of the different atoms with the equally minute high-velocity helium nuclei (alpha-particles) given off by radioactive substances, and examining the tracks of any other particles which may be generated as a result of the impact. A careful and critical examination of the results shows that hydrogen nuclei are thus expelled from the nuclei of a number of atoms such as nitrogen and phosphorus. On the other hand, oxygen and carbon do not eject hydrogen under these circumstances, although there is evidence in the case of oxygen and nitrogen of the expulsion of other sub-nuclei whose precise structure is a matter for further inquiry.

The artificial transmutation of the chemical elements is thus an established fact. The natural transmutation has, of course, been familiar for some years to students of radioactivity. The philosopher's stone, one of the alleged chimeras of the mediæval alchemists, is thus within our reach. But this is only part of the story. It appears that in some cases the kinetic energy of the ejected fragments is greater than that of the bombarding particles. This means that these bombardments are able to release the energy which is stored in the nuclei of atoms. Now, we know from the amount of heat liberated in radioactive disintegration that the amount of energy stored in the nuclei is of a higher order of magnitude altogether, some millions of times greater, in fact, than that generated by any chemical reaction such as the combustion of coal. In this comparison, of course, it is the amount of energy per unit mass of reacting or disintegrating matter which is under consideration. The amounts of energy which have thus far been released by artificial disintegration of the nuclei are in themselves small, but they are enormous in comparison with the minute amounts of matter affected. If these effects can be sufficiently intensified there appear to be two possibilities. Either they will prove uncontrollable, which would presumably spell the end of all things,[2] or they

[2] To reassure the nervous I would, however, interpolate the comforting thought that this planet has held considerable quantities of radioactive

will not. If they can be both intensified and controlled then we shall have at our disposal an almost illimitable supply of power which will entirely transcend anything hitherto known. It is too early yet to say whether the necessary conditions are capable of being realized in practise, but I see no elements in the problem which would justify us in denying the possibility of this. It may be that we are at the beginning of a new age, which will be referred to as the age of subatomic power. We can not say; time alone will tell.

THERMIONIC EMISSION

With your permission, I will now descend a little way from the summit of Mount Olympus, and devote the rest of my address to a sober review of the present state of some of the questions with which my own thoughts have been more particularly occupied. At the Manchester meeting of the Association in 1915 I had the privilege of opening a discussion on thermionic emission—that is to say, the emission of electrons and ions by incandescent bodies. I recall that the opinion was expressed by some of the speakers that these phenomena had a chemical origin. That view, I venture to think, is one which would find very few supporters now. It is not that any new body of fact has arisen in the meantime. The important facts were all established before that time, but they were insufficiently appreciated, and their decisiveness was inadequately realized.

It may be worth while to revert for a moment to the issues in the controversy, already moribund in 1915, because it has been closely paralleled by similar controversies relating to two other groups of phenomena—namely, photoelectric emission and contact electromotive force—which, as we shall see, are intimately connected with thermionic emission. The issue was not as to whether thermionic emission may be looked upon simply as a type of chemical reaction. Such an issue would have been largely a matter of nomenclature.

matter for a very long time without anything very serious happening so far as we know.

Thermionic electron emission has many features in common with a typical reversible chemical reaction such as the dissociation of calcium carbonate into lime and carbon dioxide There is a good deal to be said for the point of view which regards thermionic emission as an example of the simplest kind of reversible chemical action, namely, that kind which consists in the dissociation of a neutral atom into a positive residue and a negative electron, inasmuch as we know that the negative electron is one of the really fundamental elements out of which matter is built up. The issue in debate was, however, of a different character. It was suggested that the phenomenon was not primarily an emission of electrons from the metallic or other source, but was a secondary phenomenon, a kind of by-product of an action which was primarily a chemical reaction between the source of electrons and some other material substance such as the highly attenuated gaseous atmosphere which surrounded it. This suggestion carried with it either implicitly or explicitly the view that the source of power behind the emission was not the thermal energy of the source, but was the chemical energy of the postulated reaction.

This type of view has never had any success in elucidating the phenomena, and I do not feel it necessary at this date to weary you with a recital of the facts which run entirely counter to it, and, in fact, definitely exclude it as a possibility. They have been set forth at length elsewhere on more than one occasion. I shall take it to be established that the phenomenon is physical in its origin and reversible in its operation.

Establishing the primary character of the phenomenon does not, however, determine its nature or its immediate cause. Originally I regarded it as simply kinetic, a manifestation of the fact that as the temperature rose the kinetic energy of some of the electrons would begin to exceed the work of the forces by which they are attracted to the parent substance. With this statement there is, I think, no room for anyone to quarrel, but it is permissible to inquire how the escaping electrons

obtain the necessary energy. One answer is that the electrons have it already in the interior of the substance by virtue of their energy of thermal agitation. But thermal agitations now appear less simple than they used to be regarded, and in any event they do not exhaust the possibilities.

We know that when light of short enough wave-lengths falls on matter it causes the ejection of electrons from it—the so-called photoelectric effect. Since the formula for the radiation emitted by a body at any given temperature contains every wave-length without limitation, there must be some emission of electrons from an incandescent body as the result of the photoelectric effect of its own luminosity. Two questions obviously put themselves. Will this photoelectric emission caused by the whole spectrum of the hot body vary as the temperature of the incandescent body is raised in the way which is known to characterize thermionic emission? A straightforward thermodynamic calculation shows that this is to be expected from the theoretical standpoint, and the anticipation has been confirmed by the experiments of Professor W. Wilson. Thus the autophotoelectric emission has the correct behavior to account for the thermionic emission. The other question is: Is it large enough? This is a question of fact. I have considered the data very carefully. There is a little uncertainty in some of the items, but when every allowance is made there seems no escape from the conclusion that the photoelectric effect of the whole spectrum is far too small to account for thermionic emission.

This question is an important one, apart from the particular case of thermionic emission. The same dilemma is met with when we seek for the actual *modus operandi* of evaporation, chemical action, and a number of other phenomena. These, so far as we know, might be fundamentally either kinetic or photochemical or a mixture of both. In my judgment the last alternative is the most probable. (I am using the term photochemical here in the wide sense of an effect of light in changing the composition of matter, whether the parts affected are atoms, groups of atoms, ions, or electrons.) For example, the approximation about boiling points known as Trouton's rule is a fairly obvious deduction from the photochemical standpoint. The photochemical point of view has recently been put very strongly by Perrin, who would make it the entire *motif* of all chemical reaction, as well as of radioactivity and changes of state. In view of the rather minor part it seems to play in thermionic emission, where one would *a priori* have expected light to be especially effective, this is probably claiming too much for it, but the chemical evidence contains one item which is certainly difficult to comprehend from the kinetic standpoint. The speed of chemical decomposition of certain gases is independent of their volume, showing that the decomposition is not due to molecular collisions. The speed does, however, increase very rapidly with rising temperature. What the increased temperature can do except increase the number and intensity of the collisions, factors which the independence of volume at constant temperature shows to be without effect, and increase the amount of radiation received by the molecules, is not too obvious. It seems, however, that, according to calculations by Langmuir,[3] the radiation theory does not get us out of this difficulty; for, just as in the ordinary photoelectric case, there is nothing like enough radiation to account for the observed effects. It seems that in the case of these mono-molecular reactions the phenomena can not be accounted for either by simple collisions, or by radiation, or by a mixture of both, and it is necessary to fall back on the internal structure of the decomposing molecule. This is complex enough to afford material sufficient to cover the possibilities; but, from the standpoint of the temperature energy relations of its parts, it can not at present be regarded as much more than a field for speculation.

CONTACT ELECTRICITY

A controversy about the nature of the contact potential difference between two metals,

[3] *Journ. Am. Chem. Soc.*, Vol. XLII., p. 2190 (1920).

similar to that to which I have referred in connection with thermionic emission, has existed for over a century. In 1792 Volta wrote: "The metals . . . can by themselves, and of their own proper virtue, excite and dislodge the electric fluid from its state of rest." The contrary position that the electrical manifestations are inseparably connected with chemical action was developed a few years later by Fabroni. Since that time electrical investigators have been fairly evenly divided between these two opposing camps. Among the supporters of the intrinsic or contact view of the type of Volta we may recall Davy, Helmholtz, and Kelvin. On the other side we have to place Maxwell, Lodge, and Ostwald. In 1862 we find Lord Kelvin[4] writing:

> For nearly two years I have felt quite sure that the proper explanation of voltaic action in the common voltaic arrangement is very near Volta's, which fell into discredit because Volta or his followers neglected the principle of the conservation of force.

On the other hand, in 1896 we find Ostwald[5] referring to Volta's views as the origin of the most far-reaching error in electrochemistry, which the greatest part of the scientific work in that domain has been occupied in fighting almost ever since. These are cited merely as representative specimens of the opinions of the protagonists.

Now, there is a close connection between thermionic emission and contact potential difference, and I believe that a study of thermionic emission is going to settle this little dispute. In fact, I rather think it has already settled it, but before going into that matter I would like to explain how it is that there is a connection between thermionic emission and contact potential difference, and what the nature of that connection is.

Imagine a vacuous enclosure, either impervious to heat or maintained at a constant temperature. Let the enclosure contain two different electron-emitting bodies, A and B. Let one of these, say A, have the power of emitting electrons faster than the other, B. Since they are each receiving as well as emitting electrons, A will acquire a positive and B a negative charge under these circumstances. Owing to these opposite charges A and B will now attract each other, and useful work can be obtained by letting them come in contact. After the charges on A and B have been discharged by bringing them in contact, let the bodies be quickly separated and moved to their original positions. This need involve no expenditure of work, as the charges arising from the electron emission will not have had time to develop. After the charges have had time to develop the bodies can again be permitted to move together under their mutual attraction, and so the cycle can be continued an indefinite number of times. In this way we have succeeded in imagining a device which will convert all the heat energy from a source at a uniform temperature into useful work.

Now, the existence of such a device would contravene the second law of thermodynamics. We are therefore compelled either to deny the principles of thermodynamics or to admit that there is some fallacy as to the pretended facts in the foregoing argument. We do not need to hesitate between these alternatives, and we need only look to see how the alleged behavior of A and B will need to be modified in order that no useful work may appear. There are two alternatives. Either A and B necessarily emit equal numbers (which may include the particular value zero) of electrons at all temperatures, or the charges which develop owing to the unequal rate of emission are not discharged, even to the slightest degree, when the two bodies are placed in contact.

The first alternative is definitely excluded by the experimental evidence, so I shall proceed to interpret the second. It means that bodies have natural states of electrification whereby they become charged to definite potential differences whose magnitudes are independent of their relative positions. There is an intrinsic potential difference between A and B which is the same, at a given temperature, whether they are at a distance apart or in con-

[4] Papers on Electrostatics and Magnetism, p. 318.

[5] "Elektrochemie, Ihre Geschichte und Lehre," p. 65, Leipzig (1896).

tact. In the words of Volta, which I have already quoted, "the metals can by themselves, and of their own proper virtue, excite and dislodge the electric fluid from its state of rest."

Admitting that the intrinsic potentials exist, a straightforward calculation shows that they are intimately connected with the magnitudes of the thermionic emission at a given temperature. The relation is, in fact, governed by the following equation: If A and B denote the saturation thermionic currents per unit area of the bodies A and B respectively, and V is the contact potential difference between them at the absolute temperature T, then $V = kT/e \log A/B$ where k is the gas constant calculated for a single molecule (Boltzmann's constant), and e is the electronic charge.

I have recently, with the help of Mr. F. S. Robertson, obtained a good deal of new information on this question from the experimental side. We have made measurements of the contact potential difference between heated filaments and a surrounding metallic cylinder, both under the high-vacuum and gas-free conditions which are now attainable in such apparatus, and also when small known pressures of pure hydrogen are present. As is well known, both contact potentials and thermionic emission are very susceptible to minute traces of gas, but we find that under the best conditions as to freedom from gas there is a contact potential of the order of one volt between a pure tungsten filament and a thoriated filament. We have also been able to measure the thermionic emissions from the filaments at the same time, and we find that the contact potential calculated from them with the help of the foregoing equation is within 20 per cent. of the measured value. Considering the experimental difficulties, this is a very substantial agreement. Whilst the evidence is not yet as complete as I hope to make it, it goes a long way towards disproving the chemical view of the origin of contact potential difference.

From what has been said you will realize that the connection between contact potentials and thermionic emissions is a very close one. I would, however, like to spend a moment in developing it from another angle. To account for the facts of thermionic emission it is necessary to assume that the potential energy of an electron in the space just outside the emitter is greater than that inside by a definite amount, which we may call w. The existence of this w, which measures the work done when an electron escapes from the emitter, is required by the electron-atomic structure of matter and of electricity. Its value can be deduced from the temperature variation of thermionic emission, and, more directly, from the latent heats absorbed or generated when electrons flow out of or into matter. These three methods give values of w which, allowing for the somewhat considerable experimental difficulties, are in fair agreement for any particular emitter. The data also show that in general different substances have different values of w. This being so, it is clear that when uncharged bodies are placed in contact the potential energies of the electrons in one will in general be different from those of the electrons in the other. If, as in the case of the metals, the electrons are able to move freely they will so move until an electric field is set up which equilibrates this difference of potential energy. There will thus be an intrinsic or contact difference of potential between metals which is equivalent to the difference in the values of w and is equal to the difference in w divided by the electronic charge.[6]

PHOTOELECTRIC ACTION

We have seen that there is a connection on broad lines between thermionic emission and both contact potentials on the one hand and photoelectric emission on the other. The three groups of phenomena are also related in detail and to an extent which up to the present has not been completely explored. In order to understand the present position, let us re-

[6] This statement is only approximately true. In order to condense the argument certain small effects connected with the Peltier effect at the junction between the metals have been left out of consideration.

view briefly some of the laws of photoelectric action as they have revealed themselves by experiments on the electrons emitted from metals when illuminated by visible and ultraviolet light.

Perhaps the most striking feature of photoelectric action is the existence of what has been called the threshold frequency. For each metal whose surface is in a definite state there is a definite frequency n_0, which may be said to determine the entire photoelectric behavior of the metal. The basic property of the threshold frequency n_0 is this: When the metal is illuminated by light of frequency less than n_0 no electrons are emitted, no matter how intense the light may be. On the other hand, illumination by the most feeble light of frequency greater than n_0 causes some emission. The frequency n_0 signalizes a sharp and absolute discontinuity in the phenomena.

Now let us inquire as to the kinetic energy of the electrons which are emitted by a metal when illuminated by monochromatic light of frequency, let us say, n. Owing to the fact that the emitted electrons may originate from different depths in the metal, and may undergo collision at irregular intervals, it is only the maximum kinetic energy of those which escape which we should expect to exhibit simple properties. As a matter of fact, it is found that the maximum kinetic energy is equal to the difference between the actual frequency n and the threshold frequency n_0 multiplied by Planck's constant h. In mathematical symbols, if v is the velocity of the fastest emitted electron, m its mass, e its charge, and V the opposing potential required to bring it to rest,

$$eV = \tfrac{1}{2}mv^2 = h(n - n_0).$$

From this equation we see that the threshold frequency has another property. It is evidently that frequency for which kinetic energy and stopping potential fall to zero. This suggests strongly, I think, that the reason the electron emission ceases at n_0 is that the electrons are not able to get enough energy from the light to escape from the metal, and not that they are unable to get any energy from the light.

The threshold frequencies have another simple property. If we measure the threshold frequencies for any pair of metals, and at the same time we measure the contact difference of potential K between them, we find that K is equal to the difference between their threshold frequencies multiplied by this same constant h divided by the electronic charge e.

These results, as well as others which I have not time to enumerate, admit of a very simple interpretation if we assume that when illuminated by light of frequency n the electrons individually acquire an amount of energy hn. We have seen that in order to account for thermionic phenomena it is necessary to assume that the electrons have to do a certain amount of work w to get away from the emitter. There is no reason to suppose that photoelectrically emitted electrons can avoid this necessity. Let us suppose that this work is also definite for the photoelectric electrons and let us denote its value by hn_0. Then no electron will be able to escape from the metal until it is able to acquire an amount of energy at least equal to hn_0 from the light—that is to say, under the suppositions made—until n becomes at least as great as n_0. Thus n_0 will be identical with the frequency which we have called the threshold frequency, and the maximum energy of any electron after escaping will be $h\ (n - n_0)$.

The relation between threshold frequencies and contact potential difference raises another issue. We have seen that the contact potential difference between two metals must be very nearly equal to the difference between the amounts of work w for the electrons to get away from the two metals by thermionic action, divided by the electronic charge e. The photoelectric experiments show that the contact electromotive force is also nearly equal to the differences of the threshold frequencies multiplied by h/e. It follows that the photoelectric work hn_0 must be equal to the thermionic work w to the same degree of accuracy. We have to except here a possible constant difference between the two. I do not see, however, how any value other than zero for such a constant could be given a rational interpre-

tation, as it would have to be the same for all substances and frequencies. The photoelectric and thermionic works are known to agree to within about one volt. To decide how far they are identical needs better experimental evidence than we have at present. The indirect evidence for their substantial identity (that is to say, within the limits of accuracy referred to above) is stronger at the moment than the direct evidence.

I do not think that the complete identity of the thermionic work w and the photoelectric hn_0 is a matter which can be inferred *a priori*. What we should expect depends to a considerable extent on the condition of the electrons in the interior of metals. We can not pretend to any real knowledge of this at present; the various current theories are mere guesswork. Unless the electrons which escape all have the same energy when inside the metal we should expect the thermionic value to be an average taken over those which get out. The photoelectric value, on the other hand, should be the minimum pertaining to those internal electrons which have most energy. The apparent sharpness of the threshold frequency is also surprising from some points of view. There seems to be scope for a fuller experimental examination of these questions.

I have spoken of the threshold frequency as though it were a perfectly definite quantity. No doubt it is when the condition of the body is or can be definitely specified, but it is extraordinarily sensitive to minute changes in the conditions of the surface, such as may be caused, for example, by the presence of extremely attenuated films of foreign matter. For this reason we should accept with a certain degree of reserve statements which appear from time to time that photoelectric action is some parasitic phenomenon, inasmuch as it can be made to disappear by improvement of vacuum or other change in the conditions. What has generally happened in these investigations is that something has been done to the illuminated surface which has raised its threshold frequency above that of the shortest wave-length in the light employed in the test. Unless they are accompanied by specific information about the changes which have taken place in the threshold frequency, such statements are of little value at the present stage of development of this subject.

Interesting calculations have been made by Frenkel which bring surface tension into close connection with the thermionic work w. Broadly speaking, there can be little doubt that a connection of this nature exists, but whether the relation is as simple as that given by the calculations is open to doubt. It should be possible to answer this question definitely when we have more information about the disposition of the electrons in atoms such as the continuous progress in X-ray investigation seems to promise.

LIGHT AND X-RAYS

One of the great achievements of experimental physics in recent years has been the demonstration of the essential unity of X-rays and ordinary light. X-rays have been shown to be merely light of particularly high frequency or short wave-length, the distinction between the two being one of degree rather than of kind. The foundations of our knowledge of X-ray phenomena were laid by Barkla, but the discovery and development of the crystal diffraction methods by v. Laue, the Braggs, Moseley, Duane, and de Broglie have established their relations with ordinary light so clearly that he who runs may read their substantial identity. The actual gap in the spectrum of the known radiations between light and X-rays is also rapidly disappearing. The longest stride into the region beyond the ultraviolet was made by Lyman with the vacuum grating spectroscope which he developed. For a short time Professor Bazzoni and I held the record in this direction with our determination of the short wave limit of the helium spectrum, which is in the neighborhood of 450 Ångstrom units. More recently this has been passed by Millikan, who has mapped a number of lines extending to about 200 Ångstrom units —that is to say, more than four octaves above the violet limit of the visible spectrum. I am not sure what is the longest X-ray which has been measured, but I find a record of a Zinc

L-ray by Friman[7] of a wave-length of 12.346 Angstrom units. There is thus at most a matter of about four octaves still to be explored. In approaching this unknown region from the violet end the most characteristic property of the radiations appears to be their intense absorption by practically every kind of matter. This result is not very surprising from the quantum standpoint. The quantum of these radiations is in excess of that which corresponds to the ionizing potential of every known molecule, but it is of the same order of magnitude. Furthermore, it is large enough to reach not only the most superficial, but also a number of the deeper-seated electrons of the atoms. There is evidence, both theoretical and experimental, that the photoelectric absorption of radiation is most intense when its quantum exceeds the minimum quantum necessary to eject the absorbing electron but does not exceed it too much. In the simplest theoretical case the absorption is zero for radiations whose frequencies lie below the minimum quantum, rises to a maximum for a frequency comparable with the minimum, and falls off to zero again at infinite frequency. This case has not been realized in practise, but, broadly judged, the experimental data are in harmony with it. On these general grounds we should expect intense absorption by all kinds of matter for the radiation between the ultra-violet and the X-ray region.

The closeness of the similarity in the properties of X-rays and light is, I think, even yet inadequately realized. It is not merely a similarity along broad lines, but it extends to a remarkable degree of detail. It is perhaps most conspicuous in the domains of photoelectric action and of the inverse phenomenon of the excitation of radiation or spectral lines by electron impacts. Whilst there may still be room for doubt as to the precise interpretation of some of the experimental data, the impression I have formed is that each important advance tends to unify rather than to disintegrate these two important groups of phenomena.

O. W. Richardson

[7] *Phil. Mag.*, Vol. XXXII., p. 494 (1916).

SCIENTIFIC ABSTRACTING[1]

Is it worth while for scientific journals to provide abstracts at the beginning of their articles?

The answer to this question depends, of course, on the nature of the abstracts. If they are sketchy, incomplete and unreliable, as many abstracts published at present are, they may be worse than useless. But suppose each abstract describes the contents of the article so completely and precisely that any reader can tell with assurance whether the article contains any results of interest to him, and suppose it summarizes the methods, conclusions and theories so as to give all the information any reader not a specialist in the narrow field involved needs; that is, suppose each is the result of a careful analysis of the article by a competent abstractor, would not such abstracts enable the reader to grasp the significant results in the articles not only more quickly but more completely and clearly than by skimming through the articles?

Such abstracts would save much time for the scientist not only as a *reader* of current literature but also as an *investigator*. For when he desires information on a certain narrow subject, such abstracts would help him to determine more quickly than otherwise which of the articles referred to in a bibliography or other list contain what he needs; and frequently the abstracts would give him the information directly and make a search through the articles unnecessary. Finally, such abstracts would save his time as an *abstractor* at home and abroad. For abstract journals are recognized to be such useful, almost indispensable guides to scientific literature that most sciences have one or more in each of the great scientific languages. At present, then, most of the articles in the fields of astronomy, physics, chemistry, biology, and medicine are abstracted from three to six times each, while if an abstract suitable for reprinting in an ab-

[1] The method of analytic abstracting described in this paper was developed by the writer during 1919–20 while on the staff of the Research Information Service of the National Research Council.

stract journal were prefixed to each original article, a reabstracting of the article would be unnecessary and much duplication of effort would be avoided. Moreover the practise would enable abstract journals to report current literature with less delay than at present.

But to render this service to scientists, the abstracts must, as stated above, adequately describe and summarize the contents of the articles. The standard must not only be high; it must be uniform, so that the abstracts may be beyond suspicion of incompleteness and inaccuracy.

During 1920 the National Research Council devoted considerable attention to various questions relating to abstracts, such as: how they might be improved in form so as to render more effective service; how the rules might be made more definite and the method of preparation more systematic so as to result in more uniformly good abstracts. As a result of study and experimentation a type of abstract was developed which is believed to be well suited to the needs both of abstract journals and of scientific journals with preliminary abstracts.

Abstracts of this type, which are called *analytic abstracts,* have been appearing in the *Astrophysical Journal* and, less consistently, in the *Physical Review* since January, 1920. Their main characteristics are illustrated in the following samples.

1. *A new method of determining the atomic weight of iodine.* Marcel Guichard; Ann. chim., 6, 279–318 (1916); 7, 5–49 (1917).

ABSTRACT

Atomic weight of iodine.—The pentoxide method used involves the preparation of I_2O_5, the decomposition of this anhydrid, and the collection of the iodine by condensation and of the oxygen by combination with pure copper. The mean of five *determinations* is 126.915. The article gives in voluminous detail the refinements employed to guard against error.

Iodine pentoxide; preparation, purification and decomposition with heat.—The results of a thorough study are presented. As it was found impracticable to prepare it by direct combination of I_2 and O_2, the method adopted was to oxidize I_2 with fuming HNO_3 and subsequently expel free I_2 and HNO_3 by heating to 450°. This was carried out in an evacuated train which is fully described.

Preparation of pure iodine.—Detailed directions are given.

Occlusion of oxygen by glass, porcelain and copper was studied in order to determine the best material for the apparatus.

2. *On K. S. magnet steel.* K. Honda and S. Saito; *Physical Review,* 16, 495–500, December, 1920.

ABSTRACT

K. S. magnet steel (C 0.4–0.8, Co 30–40, W 5–9, Cr 1.5–3 per cent).—This remarkable new alloy steel possesses, when tempered, an extremely high *coercive force,* 226–257 gauss, and a strong *residual magnetism,* varying from 620 to 920 C.G.S. units for different specimens. The *effect of repeated shock* was to reduce these values by only 6 per cent. The *hysteresis curves* for a magnetizing force of ± 1300 gauss show for the hardened steel an energy loss of 900,000 ergs per cycle. *Tempering* is best effected by heating to 950° C. and quenching in heavy oil. This treatment applied to annealed specimens increases the Brinell *hardness* number from 444 to 652 and makes the *microstructure* finer grained.

3. *The structure of the helium atom.* Irving Langmuir; *Physical Review,* 17, 339–353, March, 1921.

ABSTRACT

Helium atom models.—(1) *Bohr's model* is unsatisfactory because it gives too great a value for the ionizing potential and is not in accord with some of the optical and magnetic properties of helium. Since the chemical evidence suggests that each electron in an atom has its own orbit, separated from the other orbits but closely interrelated with them, two new models are considered. (2) In the *double circle model* the two electrons are assumed to move in two circular orbits, separate

but parallel. This model, however, is unstable, for the ionizing potential computed by applying the quantum theory, comes out negative. Another objection to this model is that the magnetic moment is not zero. (3) In the *semi-circular model* each electron is assumed to oscillate back and forth along an approximately semi-circular path in accordance with classical mechanics, each being brought to rest at each end of its path by the repulsion of the other. Assuming the maximum angular momentum of each electron equal to $h/2\pi$ the absolute dimensions come out such as to give a total energy 0.9618 times that of the Bohr model, and the computed ionizing potential, 25.62 volts, agrees closely with the experimental value. The magnetic moment is zero.

Application of the quantum theory to coupled electrons.—The success of the semi-circular model of helium *suggests* that in the case of coupled electrons the quantum theory should be applied not to the momentum of the individual electrons according to the relation $\int pdq = h/2\pi$, but rather to the momentum which by being relayed from one electron to another, passes in each direction around the nucleus.

4. *Studies on inbreeding. IV. Effects of inbreeding on the growth and variability in body weight of the albino rat.* Helen D. King; *Jour. Exp. Zool.*, 29, No. 1 (1919).

ABSTRACT

Effects of inbreeding on the growth and variability in body weight of the albino rat.—In continuation of previous work, data are given concerning over 600 rats belonging to the *sixteenth to twenty-fifth generations* of a strain bred brother to sister from the same litter only. Allowing for the effect of certain unfavorable conditions, determined by control rats, the results confirm previous conclusions and show that close inbreeding continued for 25 generations has not produced any deterioration in the stock as regards the growth curve, the body weight, the variability of body weight for various ages, and the relative behavior of the sexes in these respects. Selected rats were used as the parents of each generation. If there is any tendency to deterioration it was counteracted in these experiments by the selection employed.

Effect of nutrition on the growth and variability in body weight of the albino rat.—Rats are particularly sensitive to food conditions. Alfalfa, cottonseed and linseed meal were found to be injurious. A change from a satisfactory diet to one less suitable resulted in a marked increase in variability of body weight both for inbred and stock rats.

Sex ratio in the albino rat.—By selection the inbred strain has been separated into two lines, one with a high, the other with a low, sex ratio; but the *effect of selection* seems to be limited. The two strains are alike in body weight, growth curve and variability of body weight.

It will be noticed that each of the one or more paragraphs of each abstract begins with an italicized *paragraph title.* In some cases words or phrases within a paragraph are also italicized. This is not done for emphasis but to associate them with the paragraph titles which they supplement and complete. Paragraph titles and italicized words and phrases will collectively be called *subtitles.* If the reader will run through the sample abstracts, skipping all but these italicized subtitles, he will get in each case a descriptive index of the information in the article. For example:

ABSTRACT NO. 1

Atomic weight of iodine.
  Pentoxide method.
  Determinations.
Iodine pentoxide.
  Preparation, purification.
  Decomposition with heat.
Preparation of pure iodine.
Occlusion of oxygen by glass, porcelain and copper.

ABSTRACT NO. 3

Helium atom models.
  (1) *Bohr's model.*
  (2) *Double circle model.*
  (3) *Semi-circular model.*

Application of the quantum theory to coupled electrons; suggestion.

The subtitles, then, form in each case an *index of the abstract.* By glancing through them a reader can tell with assurance whether the article deals with anything of interest to him. It is well known that one can not rely upon the author's title alone, for many articles contain incidental information or a variety of information which a short title can not fully describe. The first and last articles abstracted above are good instances of this fact. On the other hand, the subtitles of this type of abstract, since they may be as numerous as is necessary, can give in all cases the precise scope of the information contained in the article; in particular they can call attention to incidental results whose presence would not be suspected from the title, such as the data relating to the occlusion of oxygen given in the article on the atomic weight of iodine.

Besides providing a complete index in the form of subtitles, the abstracts are required to describe the new information with sufficient precision and to summarize the results with sufficient completeness and in sufficient detail to satisfy the needs of the great majority of readers. Each abstract should be a carefully prepared report on the contributions to scientific knowledge set forth in the article, by a scientist who feels his responsibility to his scientific colleagues to make it complete and accurate.

But why go to the trouble of preparing such abstracts? Why not let each reader glance through each article and determine what it contains for himself? Because for each scientist to do his own abstracting, as this would amount to, is as wasteful as for each to prepare his own indexes of the reference books he uses; it means not only an unnecessary duplication of effort but, worse still, a poor quality of abstracting, in most cases. Then there is the waste involved in the simultaneous abstracting of each article by several abstract journals to be considered. Efficiency demands that a good preliminary abstract be provided with each article, so that all readers may benefit by the careful work of one abstracter and none need abstract that article again.

Anyone may readily convince himself of the value of preliminary analytic abstracts if he will turn to one of the longer articles in the *Astrophysical Journal* since January, 1920, and, after spending three to five minutes in abstracting the article for himself by glancing through it, will compare the information he thus gains with what he might have obtained in an equal time from the abstract.

There can be no doubt, then, that good preliminary abstracts would save much time for scientists as readers, investigators and abstractors. But is this of any importance? Before the War many would have said, No. Research was generally regarded as a hobby. Now it is more generally realized that the research output of the country is a matter of national concern and is an important factor in national progress.

The number of scientists actively engaged in research work is relatively small. Their research time is correspondingly valuable, especially as it is further limited by the fact that most of them have teaching or executive duties which take much of their energy. Of this time the larger the part devoted to securing the necessary foundation of scientific information, both current and past, the less the part available for actual research. Therefore, everything possible should be done to make it as easy as practicable for each investigator to obtain the information he needs; that is, *our whole scientific information service, including original scientific journals, abstract journals, handbooks, tables, etc., should be made in its parts and as a whole, as efficient as possible.* All this is self-evident. In this note we are considering merely the scientific journals. Their part is to provide preliminary abstracts. And since this can be done at very small additional expense to each and since the saving of time for scientists would be in the aggregate considerable, surely there can be no question as to the advisability of the adoption of this policy by every scientific journal.

What obstacles stand in the way? The additional expense is, as just stated, small. The

abstract would be less than five per cent of the article on the average, and if the summary usually placed at the end were omitted, as could well be done because its function would be served by the abstract, the increase in length of the article would be little or nothing. But, on the other hand, the addition of abstracts would undoubtedly considerably increase the burdens of the already overburdened editors, and one would shrink from suggesting that they add to their labors the drudgery associated with securing and editing the abstracts if it were not clear that the gain to the many investigators would be many times the cost to the few.

At present, in addition to the *Astrophysical Journal, Physical Review,* and *Journal of the American Ceramic Society,* which require analytic abstracts, the following fourteen scientific and engineering journals give preliminary abstracts: The group of biological journals published by the Wistar Institute of Anatomy and Biology—*American Journal of Anatomy, American Anatomical Memoirs, Anatomical Record, Journal of Comparative Neurology, Journal of Experimental Zoology,* and *Journal of Morphology; Physiological Researches; Proc. of London Physical Society, Trans. of American Electrochemical Society, Trans. of American Institute of Electrical Engineers, Trans. of American Society of Civil Engineers, Trans. of American Society of Mechanical Engineers, Trans. of Society of Automotive Engineers,* and *Trans. of American Foundrymen's Association.* The abstracts now being provided by these journals are prepared as a rule by the authors and vary greatly in quality. It would be relatively easy for those journals whose abstracts are not as useful as is desirable to change their rules so as to require abstracts of the quality of analytic abstracts.

The directions and rules which have been formulated for the guidance of authors in the preparation of analytic abstracts may be found in current numbers of the *Astrophysical Journal* and also, somewhat abbreviated, in those of the *Physical Review* and of the *Journal of the American Ceramic Society.* With slight modification they would serve for any science. But while some authors will take the trouble to master the technique and prepare satisfactory abstracts, a uniformly high standard can not be maintained unless all the abstracts for each journal are checked and revised by a competent abstractor. Therefore, after deciding to require analytic abstracts, the first step taken by a journal should be the selection of a suitable man as abstract editor. If the man appointed should care to get in touch with me, I should be glad to give any assistance I can in getting the new policy started.

In conclusion, attention should be directed to the fact that those journals which provide analytic abstracts may easily combine an index of the subtitles in the abstracts with the usual index of author's titles, and thus greatly increase the completeness and precision of their subject indexes and hence the value of the journal for reference purposes.

It may not seem of much importance whether any particular journal provides efficient abstracts or not. Yet it is clearly the duty of each to do so. For when all have adopted this policy and the abstract journals promptly reprint all the abstracts and completely index them, we shall have gone far toward making our scientific information service really efficient. And because of the cooperation involved, it will require less effort to maintain than our present much less efficient service.

GORDON S. FULCHER
CORNING GLASS WORKS

SCIENTIFIC EVENTS

THE NATIONAL COMMITTEE ON MATHEMATICAL REQUIREMENTS

THE National Committee on Mathematical Requirements on September 5 held its last meeting under its present form of organization. The manuscript of a summary of the final report of the Committee has been sent to the U. S. Bureau of Education for publication. This summary, which will constitute a bulletin of some eighty pages, virtually presents the first part of the complete report. It contains the following chapters:

I. A Brief Survey of the Report.

II. Aims of Mathematical Instruction—General Principles.

III. Mathematics for Years Seven, Eight and Nine.

IV. Mathematics for Years Ten, Eleven and Twelve.

V. College Entrance Requirements in Mathematics.

VI. List of Propositions in Plain and Solid Geometry.

VII. The Function Concept in Elementary Mathematics.

VIII. Terms and Symbols in Elementary Mathematics.

It will also include a brief synopsis of the remaining chapters of the complete report. It is expected that this summary will appear late in November or early in December.

It was the original intention of the Committee to publish its complete report also through the U. S. Bureau of Education. It was found, however, that this would involve a delay of two or three years in view of the fact that it would have been necessary for the Bureau of Education to issue the report in parts extending over a considerable period of time. It is hoped at present that sufficient funds will be obtainable to print the report during the winter and to distribute it free of charge to all who are sufficiently interested to ask for it. The complete report will constitute a volume of about five hundred pages. In addition to the chapters listed in the summary, it will contain an account of a number of investigations instituted by the Committee. Among these may be mentioned:

The Present Status of Disciplinary Values in Education.

A Critical Study of the Correlation Method Applied to Grades.

Mathematical Curricula in Foreign Countries.

Mathematics in Experimental Schools.

The Use of Mental Tests in the Teaching of Mathematics.

The Training of Teachers of Mathematics.

There will also be included an extensive bibliography on the teaching of mathematics.

HENRY WOODWARD

We regret to record the death of Dr. Henry Woodward, F.R.S., which occurred on September 7 at his home in Bushey, England. Dr. Woodward was in his ninetieth year and in his long life had achieved very great distinction for his labors in the sciences of geology and paleontology. Dr. Woodward spent the early years of his life in business, but in 1858 he entered the British Museum, and in 1880 was made keeper of geology, a position which he held for 25 years. Though he was a profuse writer on various geological and paleontological subjects, his special interest lay in the study of the fossil crustacea, and perhaps his most keenly analytical work was in the field of the fossil merostomes. He was the president of the Palæontographical Society and had been the president of the Royal Microscopical Society as well as of the Geological Section of the British Association for the Advancement of Science and of the Geological Society of London. He was the president and founder of the Malacological Society and had been the president of the British Museums Association. In 1862, with the late Professor T. Rupert Jones, he founded the *Geological Magazine*, of which he remained the editor until the time of his death.

Doctor Woodward kept his intellectual vigor and his interest in his science up to the last and passed away peacefully after a very brief illness.

J. M. C.

PROFESSOR PAWLOW

Professor W. B. Cannon, of the Harvard Medical School, writes to the editor of the *Journal* of the American Medical Association as follows:

In *The Journal*, September 3, there is a letter from Budapest, dated July 12, 1921, in which it is stated that Pawlow, the great Russian physiologist, had died in January, 1921. You may know that several years ago there was a rumor that he had died, which proved to be incorrect. Apparently the statement from Budapest is likewise incorrect. I have a copy of a letter from Dr. Edward W. Ryan, commissioner of the American Red Cross to western Russia and the Baltic States, written from Riga, March 23, 1921, to Col. Robert E. Olds, commissioner of the Red Cross in Europe.

Dr. Ryan declares that the Red Cross was sending Professor Pawlow food and states that Pawlow's two sons, Victor and Vsevolod Ivanovitch, had not been heard from for two years and that he was very desirous of obtaining information regarding them. Again, April 24, Dr. Ryan reported that he had been able to send to Pawlow certain definite supplies which are listed. Furthermore, I have a letter from Professor Carl Tigerstedt of Helsingfors, Finland, dated July 30, 1921, in which he acknowledges the receipt of money collected from friends of Pawlow in the United States and sent to him for Pawlow's aid. The Finns have official representatives in Petrograd. Dr. Tigerstedt reports that he has been sending a consignment of food of all kinds twice monthly to Pawlow through the Finnish commission, and that he is thus not suffering any more from lack of nourishment. Nevertheless, I am sending to Dr. Tigerstedt the report from Budapest and asking for specific information regarding Pawlow's welfare.

SCIENTIFIC NOTES AND NEWS

Dr. C. S. Sherrington, professor of physiology at Oxford University and president of the Royal Society, will be elected president of the British Association for the meeting to be held at Hull in 1922. It is expected that the meeting of 1923 will be at Liverpool and the meeting of 1924 at Toronto.

The International Eugenics Congress has been holding a successful meeting in New York City. We hope to publish next week the addresses given at the opening session by Dr. Henry Fairfield Osborn, Major Leonard Darwin and Professor Charles B. Davenport.

The thirteenth course of lectures on the Herter Foundation at the Johns Hopkins University will be given by Sir Arthur Keith, F.R.S., conservator of the Museum and Hunterian professor of the Royal College of Surgeons, England. The lectures will be given on October 5, 6 and 7, the subject being "The differentiation of modern races of mankind in the light of the hormone theory."

At the recent meeting of the American Astronomical Society, held at Middletown, Conn., Professor C. V. L. Charlier was elected an honorary member. Professor J. C. Kapteyn and Sir Frank Dyson are the only other living astronomers who have been thus honored.

Professor Robert W. Hegner, of the department of medical zoology, school of hygiene and public health, Johns Hopkins University, has been elected a fellow of the Royal Society of Tropical Medicine and Hygiene, London, England.

Dr. Heber W. Youngken, professor of botany and pharmacognosy in The Philadelphia College of Pharmacy and Science was elected chairman of The Scientific Section of The American Pharmaceutical Association at its sixty-ninth annual convention held in New Orleans, from September 5–9.

Willard Rouse Jillson, director and state geologist of the Kentucky Geological Survey with offices at Frankfort, Kentucky, received the doctorate of science from Syracuse University at its fiftieth commencement last June.

Professor J. J. Thornber has been appointed director of the Agricultural Experiment Station of the University of Arizona, at Tucson, and began his work on September 1. Professor Thornber has completed twenty years' continuous service as head of the department of biology in the College of Letters, Arts and Sciences, University of Arizona, and henceforth will devote his time to administrative work and investigation.

Professor R. J. Terry, of the department of anthropology of Washington University, Saint Louis, has been appointed anthropologist to the Barnes Hospital and Saint Louis Children's Hospital.

Dr. Michael F. Gardner has been appointed chief of the Bureau of Preventable Diseases and director of the bacteriological laboratory of the U. S. Public Health Service.

The Fixed Nitrogen Research Laboratory, together with about a half million dollars from the original appropriation made for the investigation of nitrogen fixation, was transferred on June 30 from the jurisdiction of the War Department to the Department of Agriculture. The laboratory is now an independent unit of the Department of Agriculture, under the direction of Dr. Richard C. Tolman, who has the assistance of an advisory committee

made up of a representative of the War Department and representatives of the agricultural bureaus which are directly interested in the fixation of nitrogen. It is expected that the present allotment will maintain the laboratory for about two years.

The Sections of Eastern and Western Areal Geology in the U. S. Geological Survey have been merged into one section under the direction of Mr. Sidney Paige.

Upon nomination of the French Government, the Harvard University corporation has appointed Emile F. Gautier, professor of geography in the University of Algiers, as the French exchange professor at Harvard this year. He will lecture at Harvard during the second half-year. Professor Maurice DeWulf, who was one of the Louvain University (Belgium) teachers invited to Harvard after the destruction of the university by the Germans in 1914, has now been invited to return on a permanent appointment as professor of philosophy.

M. J. Cavalier, professor of metallurgy in the University of Toulouse, has arrived in New York City to take up his work as French exchange professor at Columbia University. He will be at Columbia from October 1 to October 30. Professor Cavalier, rector of Toulouse University, known as an authority on metallurgical chemistry, comes to America as the result of arrangements for an annual exchange of professors of engineering and applied science between French and American universities. Professor Cavalier will divide his time among Columbia, Harvard, Yale, Cornell, Johns Hopkins, Massachusetts Institute of Technology and the University of Pennsylvania.

Professor Reginald A. Daly and Professor Charles Palache of Harvard University are members of the Shaler Memorial Expedition to South Africa. A large part of Dr. Daly's work will be conducted by Dr. Eliot Blackwelder, chief geologist of the Argus Oil Company at Denver.

The British Tropical Disease Prevention Association is sending out a mission under Dr. Claude H. Marshall, a senior medical officer in Uganda, whose services are being lent by the government of Uganda for that purpose, to investigate certain methods of treating trypanosomiasis.

Professor S. Kato, Keio University Medical College, Japan, plans to visit colleges and laboratories in Germany, Austria, Denmark, Belgium, France and England. He expects to return to Japan by way of America. He expected to leave Japan on September 30.

Mr. F. W. L. Sladen, the well known authority on bees, and author of "The Humble-Bee," was accidentally drowned at Duck Island, Lake Ontario, on September 10. Mr. Sladen was carrying on research work in bee breeding on this island.

In memory of the late Dr. Susumu Sato, who devoted his life to the progress of medical science in Japan, a laboratory will be constructed at a cost of 300,000 yen, for the Yuntendo Hospital, the largest private hospital in Japan. Courses in every branch of medical science will be offered under the presidency of Dr. Susumu Nukada, and clinics will also be held in the institution.

We learn from the *Journal* of the Washington Academy of Sciences that at the invitation of Mr. Northcott, owner of the Luray Caverns, Virginia, Dr. Ales Hrdlicka of the National Museum has visited the caverns for the purpose of examining and removing certain bones, enclosed in stalagmite, which were believed to be human. After considerable difficulties, the entire deposit containing the bones was taken out in pieces which showed the remains of most of the parts of a human skeleton; but no trace remained of the skull with the exception of a portion of the lower jaw. The specimens have been given to the museum for further study.

It has been finally decided to hold the International Congress for Comparative Pathology at Rome, beginning on September 20, 1922, under the presidency of Professor Perroncito. The *Riforma Medica* of August 13, 1921, gives the list of twenty subjects appointed for discussion, and communications

on other subjects are invited by Professor Perroncito, whose address is R. Universita di Torino.

The British Medical Journal reports that at the second Congress of the History of Medicine in Paris last July it was agreed that the third Congress, to be held in July, 1922, should take place in London. There will be a meeting for business purposes towards the end of this year in Paris, which will be attended by Dr. Charles Singer, president of the Section of the History of Medicine of the Royal Society of Medicine, when the permanent organization of the congress will be discussed. A meeting of the Section of the History of Medicine will be held on October 5, to forward the arrangements for the London Congress of 1922.

THE *Journal* of the American Medical Association reports that the purpose of the Belgian University Foundation, which was established by law, July 6, 1920, is the advancement of science and learning: (1) by granting to young Belgians who are gifted but are without financial resources loans that will allow them to take up university studies; (2) by granting financial aid to scientists and to young men who are planning to teach higher subjects or to undertake scientific researches, and (3) by encouraging scientific relations between Belgium and other countries. With the last mentioned aid in view, the foundation will aid physicians engaged in medical instruction in foreign countries. It will keep in close touch with the Association pour le développement des relations médicales de la faculté de médecine de Paris, the Office national des universités françaises, the Universities Bureau of the British Empire, the American University Union and the Junta para ampliación de estudios de Madrid.

IT is announced in *Nature* that the Ministry of Agriculture and Fisheries and the Royal Horticultural Society have arranged to hold an International Potato Conference in London on November 16–18 next. During the conference, which will take place at the hall of the Royal Horticultural Society, Vincent Square, the National Potato Society will hold its annual show, at which it is expected that most British varieties of potatoes will be exhibited. An exhibit dealing with the scientific aspect of potato problems is also being arranged, and it is hoped that workers engaged on potato problems in all parts of the world will cooperate. The proceedings will open with Sir A. Daniel Hall's presidential address on the morning of November 16. Papers on the breeding and selection of potatoes in Great Britain and the United States, and on wart disease, potato blight, and other diseases which are botanically and economically important, will be read, and time has been allowed for their discussion. Invitations to attend the conference have been extended to the Dominions and Colonies and to foreign countries, and it is hoped that the meeting will be throughly representative from both the scientific and the commercial aspects.

WITH the approach of cold weather renewed activity in the radio market news service is planned by the Bureau of Markets and Crop Estimates, United States Department of Agriculture, for the eight months beginning October 1. Atmospheric conditions are unfavorable to radio communication in warm weather, and many amateurs and experimenters discontinue their operations during the summer. It is expected, however, that with the coming of autumn the interest in radio activity will increase. Many states have shown keen interest in the development of radio news service covering market, crop and weather reports. State cooperation is planned by the bureau and will be taken up with the various states within range of the radio stations. The states that cooperate will be asked to determine the agency or agencies that are to work with the federal bureau in order to prevent duplication of effort. The handling of news matter will necessarily vary with the different states, depending on administrative organizations, geographical position, climate, and other factors.

CORN that grew in Tennessee in pre-historic times was unearthed recently by W. E. Meyer, of the Bureau of American Ethnology, and sent to the United States Department of Agricul-

ture for identification. During recent excavations in Davidson County, Tenn., Mr. Meyer came upon a number of stone slab graves containing mortuary vessels. Some of these held specimens of charred maize in fairly good condition. From the size and shape of the grains it was possible to identify the variety as Many-Rowed Tropical Flint, a form about half way between true flint and popcorn. The same type of Indian corn occurs in the West Indies, and there appears to have been a very early communication between the West Indies and North America. Not only corn but beans, squashes, pumpkins, and tobacco are of tropical and subtropical origin. These staples, now so important throughout both hemispheres, found their way into North America and were cultivated beyond the Great Lakes in Canada long before the discovery of America. There is abundant evidence of communication between the West Indies and Florida, and up the Mississippi and its tributaries.

The *Brazil Medico* announces that Dr. Cleef, professor of chemistry at Bello Horizonte, reports the discovery in Minas Geraes of a mineral substance hitherto unknown which possesses great radioactive properties.

UNIVERSITY AND EDUCATIONAL NEWS

Yale University has begun the construction of the new Sterling Chemical Laboratory. It is hoped that this building will be ready for the use of the department of chemistry in October, 1922.

New members of the faculty at the University of North Carolina, at the beginning of the fall term include G. M. Braune, professor of civil engineering; H. B. Anderson, associate professor of pathology; H. F. Janda, associate professor of highway engineering; F. C. Vilbrandt, associate professor of industrial chemistry; H. W. Crane, associate professor of psychology, and E. L. Mackie, assistant professor of mathematics,

Miss Edith Nason, Ph.D., Yale, 1921, has been appointed an instructor in organic chemistry at the University of Illinois.

Mr. Henry R. Henze, who received his Ph.D. degree from Yale in June, 1921, has become adjunct professor of chemistry in the medical school of the University of Texas at Galveston.

DISCUSSION AND CORRESPONDENCE

A NEW DEFINITION OF PURE MATHEMATICS

During the present year there appeared a volume of the *Acta Mathematica*, volume 38, which was dedicated to the memory of H. Poincaré, the noted French mathematician who died in 1912. This volume opens with an account of his own works by Poincaré in which he deals briefly with his own contributions to the advancement of various subjects. This is followed by a report on the theory of groups and the works of E. Cartan, which Poincaré read before the council of the faculty of sciences of the University of Paris on the eve of the operation resulting in his death. The rest of the volume is devoted to letters and to various articles written by others but relating to Poincaré and his works.

In the present note we desire to direct attention to the second article mentioned above, which seems to be one of the last articles, if not the last article, written by Poincaré, and contains some remarkable statements in regard to the theory of groups. One of these is as follows: "The theory of groups is, so to say, entire mathematics, divested of its matter and reduced to a pure form." The interest in this statement should be increased by the fact that it may be regarded as a new definition of pure mathematics, the skyscraper among scientific structures. One of the best known other definitions is due to B. Peirce, who stated that "mathematics is the science which draws necessary conclusions." It should, however, not be inferred that the latter definition has been generally accepted as an entirely satisfactory one, nor do we want to create the impression that the former is likely to be universally adopted.

It may, however, be a matter of wide interest to see what Poincaré meant by the statement quoted above. Such an insight can probably be best gained by reading his own

preliminary remarks, which are, in part, as follows:

The preponderant rôle of the theory of groups in mathematics has been unsuspected for a long time. Eighty years ago even the name of group was unknown. It was Galois who first had a clear notion of it, but it is only since the works of Klein, and especially of Lie, that one has begun to see that there is almost no mathematical theory in which this notion does not occupy an important place. . . . It is necessary to give the same name to different things, but on condition that these things are different as to matter but not as to form. What is the cause of the mathematical phenomenon so often constant? And, on the other hand, of what consists the community of form which subsists under the diversity of matter? It is due to this that every mathematical theory is, in the last analysis, the study of properties of a group of operations, that is to say, of a system formed by certain fundamental operations and of all the combinations which can be made therefrom.

If, in another theory, one studies other operations which combine according to the same laws one will naturally see a set of theorems, having a one to one correspondence to those of the first theory, unfold themselves, and the two theories may be developed with a perfect parallelism; an artifice of language like those of which we just spoke, suffices to make this parallelism manifest and to give almost the impression of a complete identity. One says then that the two groups of operation are isomorphic, or that they have the same structure. If then one divests the mathematical theory of this which appertains to it only by accident, that is to say, its matter, there will remain only the essential, that is to say, the form; and this form, which constitutes, so to say, the solid skeleton of the theory, will be the structure of the group.

G. A. MILLER
UNIVERSITY OF ILLINOIS

GALL EVOLUTION: A NEW INTERPRETATION

PRACTICALLY all gall students to date have regarded cecidia as responses to specific stimuli relating specific differences causally to the plant bearing the gall.

Basing his ideas on Küster's logical classification of galls (structurally considered) into "kataplasmas" (galls of indefinite character; ex. oak knot gall, *Andricus punctatus* Bass.) and "prosoplasmas" (galls of definite character; ex. oak apple, *Amphibolips inanis* O. S.) together with Cook's recognition of the influence of the animal in gall formation, the writer has developed a new theory of gall evolution.

The new interpretation holds that phylogenetically prosoplasmas have been derived from kataplasmas. Further, kataplasmic evolution involves progressive inhibition of the normal differentiation of the plant part until homogeneity is reached. Not until kataplasmic evolution has been completed is it possible for prosoplasmic evolution to begin its course in which fundamentally new tissue orientations and forms are produced. Thus from the standpoint of the plant's differentiation we have first a regressive movement (kataplasmic) and then a progressive one (prosoplasmic) but from the standpoint of the animal the series should be regarded as progressive throughout.

A corollary of the above interpretation is the striking situation that an animal may not only inhibit the expression of a plant's characters but may introduce new ones, or in other words the evolution of the animal induced galls (zoocecidia) is primarily or fundamentally related to the animal. The initiating changes producing the different gall types probably occur in the germ plasm of the animal. This means that the evolution process carried out in the animal comes to expression in the plant, an interesting situation to say the least.

The evidence for the above theory drawn from the fields of comparative morphology and embryology appears to the writer to be overwhelming.

The writer has presented this thesis at greater length in the May, 1921, number of the *Botanical Gazette*.

B. W. WELLS
NORTH CAROLINA STATE COLLEGE

ON SOUNDS ACCOMPANYING AURORAL DISPLAYS

TO THE EDITOR OF SCIENCE: The existence of sounds in connection with manifestations of the aurora is regarded by many as still a

moot point, *cf.* the remarks at the close of the article on the subject in the Encyclopedia Britannica.

Several observers have reported hearing such sounds during the very brilliant auroral display of May 14. I could not detect any such sounds on this occasion, doubtless owing to the proximity of a large city from which the volume of sound, even at 3 A.M., is quite noticeable.

I desire to place on record, however, certain earlier experiences under almost perfect conditions of isolation and quiet. While in charge of the Labrador station of the Lick Observatory-Crocker Eclipse Expeditions of 1905, much of the work of adjusting the instruments was necessarily done at night. The station was located at Cartwright (latitude +53° 42′), and auroral displays were frequent and bright during July and August. On several nights I heard faint swishing, crackling sounds which I could attribute only to the aurora. There were times when large faintly luminous patches or "curtains" passed rapidly over our camp; these *seemed* to be close and not more than a few hundred feet above the ground, though doubtless much higher. The faint hissing and crackling sounds were more in evidence as such luminous patches swept over us.

Heber D. Curtis
Allegheny Observatory,
August 10, 1921

LAWRENCE'S WARBLER

To the Editor of Science: It may be worth while to record the presence of the rare *Vermivora (Helminthophila) lawrencei* (Herrick) in Lexington, Virginia, on May 14. The warbler was observed sitting on a telephone wire less than ten yards from the porch of a house just on the outskirts of town, and its conspicuous black throat patch and white wing bars served to fully identify it, and differentiate it from *V. pinus* and *V. chrysoptera,* of which it is supposed to be a hybrid. Chapman speaks of it as much rarer than Brewster's warbler, *V. leucobronchialis,* the other supposed hybrid of these species, and says that less than a dozen specimens have been recorded.

Jas. Lewis Howe
Washington and Lee University,
Lexington, Virginia

QUOTATIONS

CHEMISTRY IN WAR

Two distinguished chemists have recently made pronouncements, identical on the material side, divergent on the moral side, on the use of posion gas in war. It is a question on which civilization will have to come to a decision or to live under lasting and increasing menace. Sir T. Edward Thorpe, in his presidential address to the British Association, at Edinburgh, told his audience that the Germans, between April, 1915, and September, 1918, had used no fewer than eighteen different forms of poison—gases, liquids, and solids—in their military operations. Reprisals became inevitable, and for the greater part of three years the leading nations of the world were flinging the most deadly products at one another that chemical knowledge could suggest and technical skill contrive. Sir William Pope, an equally eminent English chemist, speaking at Montreal a few days before, said that by the Armistice the Allies had sufficient supplies of mustard gas to "have enveloped the Germans knee deep, and had discovered a new vapor against which respirators would be of no avail, so strong that it would stop a man if it were present in the atmosphere in the proportion of one part in five millions." The President of the British Association admitted that warfare had now definitely entered on a new phase. But in passionate words he deplored the prospect on the part of science and of humanity, and hoped that, through the League of Nations or by some other form of international agreement, it might be averted. Sir William Pope, on the other hand, claimed that from the humanitarian point of view gas was more merciful than high explosives, and stated his belief that chemical agencies would be the sole deciding factor in future wars.

Certainly even the eighteen poisons used by the Germans and the counter-efforts actually brought into operation by the Allies were the fumbling of experimental amateurs compared with what might follow a new outbreak of hostilities between great manufacturing and scientific nations. Poison could suddenly extinguish all life over so many square miles of territory, over a walled city, or a navy in its harbor. Science could provide the formula, industrial chemistry the substance, and aeroplanes the means of distribution. Were poison gas a specialized and secluded branch of chemistry there might be some hope that science might refuse to pervert its high mission from the service to the destruction of mankind. But such a possibility does not arise, because the discovery of noxious substances is an inevitable side issue of the pursuit of chemical knowledge. The world must either face and prepare for the future, or it must prohibit chemical warfare by an international agreement supported by effective international sanctions.—The London *Times*.

SCIENTIFIC BOOKS

BIBLIOGRAPHY OF RELATIVITY

THE great interest in any scientific or philosophic discovery generally calls forth semi-scientific and learned discussion, followed by a demand for literature, historical and recent, upon this particular subject.

The literature of the theory of relativity is recent and more or less familiar to the scientist. Before 1905, the year in which Dr. Albert Einstein brought forward his fundamental and special theory, the literature was scattered and bore indirectly upon the theory of relativity as we know it to-day. The literature is quite extensive, however, from 1905 to the time of the British solar eclipse expedition in May, 1919, the results of which placed the theory of relativity in a more or less acceptable light, that is, the mathematical and physical aspects found verification in the astronomical interpretations.

In view of the fact that the subject of relativity will probably have great influence upon future problems in physics and astronomy, due to its mathematical character, and that the history of this development can best be served when the literature is known and organized, a bibliography should prove of great value.

The present note is to call attention to the fact that an extensive and as complete a bibliography as is possible, is in process of being compiled. And thus far the writer has collected approximately one thousand titles of books, pamphlets, articles and notes published in all languages to which it is possible to obtain access. The John Crerar Library seems the most logical place to form this bibliography due to its great collection of scientific literature. The philosophical literature bearing upon this question (relativity) fortunately falls within the scope of the library's collection.

It is hoped that each entry upon the typewritten card will contain, besides the author, title, source, date, also a short abstract, note or review indicating just what the principal idea is that the author has conveyed. A mere author-title list is for current use and answers only half of what a true bibliography ought to be, and therefore is quite unsatisfactory. Over 90 per cent. of the titles represent material in The John Crerar Library, and it is planned to make the collection in the library as complete as possible, bearing upon relativity.

The question of publishing this bibliography is a difficult one, and at present no provision has been made for it.

What form of bibliography will be most valuable for scientific purposes is an open question. There are as many types as there are demands for certain use. An alphabetical author-title list serves one certain demand, and a chronological author-title list serves another. One might be analytical and another synthetical in its aspect. A synthetical bibliography must be selective, critical and constructive [1]; add to this abstract, notes and reviews, and it would be a bibliography worthy of its name.

[1] Dr. George Sarton, *Isis*, III., 159–170, No. 8, Autumn, 1920.

From the point of view of the future historian this would serve as a large labor-saving device, especially in view of the fact that human knowledge is ever becoming more specialized.

It might be well to call attention to the fact that a bibliography of relativity has also been in progress in England,[2] namely, the International Catalogue of Scientific Literature, under the direction of Dr. H. Forster Morley. Dr. Morley has made a selected chronological bibliography of relativity and related problems from 1886 to the end of 1920.

The recent visit of Dr. Albert Einstein has not alone stimulated interest among scientific men, but he has strengthened his theory by his own clear presentation of relativity.

Of course the theory has yet to receive its final verification, before the whole can be accepted, and Dr. Einstein has expressed confidence in the final answer.

Not since the doctrine of evolution was promulgated, has any advance of intellectual progress, either of philosophic or scientific importance, caused such profound interest, popular or scientific, as the theory of relativity. And like all epoch-making ideas, the synthetical character of the theory of relativity will mark off a period of great importance in the history of science. Hence the value of a bibliography of a subject in relation to the history of science is in direct proportion to the importance of the subject itself.

FREDERICK E. BRASCH
THE JOHN CRERAR LIBRARY,
CHICAGO, ILLINOIS

SPECIAL ARTICLES

EINSTEIN'S COSMOLOGICAL EQUATIONS

IN two earlier notes published in SCIENCE (Vol. 52, p. 413, Vol. 53, p. 238) I gave certain geometrical theorems connected with Einstein's original (1914) equations of gravitation, $G_{ik}=0$ (in space free from matter). I shall now extend some of the results so as to apply to the modified equations employed in Einstein's cosmological speculations. These he first wrote (1917) in the form, $G_{ik}-\lambda g_{ik}=0$; but more recently (1919) he has employed the form $G_{ik}-\frac{1}{4}g_{ik}G=0$, which includes the previous form and which, when the energy impulse tensor T_{ik} is introduced in the right hand member, has the advantage of being possibly applicable to the microcosm (atoms and electrons) as well as to the macrocosm (the stellar universe). Here G_{ik} is the contracted curvature tensor and G is the scalar curvature.

For brevity we shall term any four dimensional manifold which obeys the last equations, a cosmological solution.

I. The only cosmological solutions which have the same light rays as the euclidean or Minkowski world are those which have constant curvature in the sense of Riemann. In other words, if a cosmological world is to admit conformal representation on a euclidean world, it must be of spherical (or pseudospherical) character. This result is analogous to the earlier result for $G_{ik}=0$, that the only manifolds having the Minkowski light equation are flat (zero curvature). Both results are obviously valid also for geodesic representation (same equation of orbits).

II. Here we discuss four-dimensional curved manifolds which can be regarded as imbedded in a flat space of five dimensions. Our result is that for the cosmological equations, there are two distinct possibilities.

(a) In the first case at every point of the manifold the four principal curvatures are equal, that is $K_1=K_2=K_3=K_4$, so that every point is umbilical. The manifold is then simply a hypersphere.

(b) In the second case $K_1=K_2=-K_3=-K_4$, that is, the four principal curvatures are numerically equal, but two are positive and two are negative. Such manifolds may be regarded as a generalization of ordinary minimal surfaces (where $K_1=-K_2$), and may be described as hyperminimal spreads. (It would be interesting to find an actual example in finite form of such a spread.)

It will be recalled that for our previous discussion of $G_{ik}=0$, no solution in five dimen-

[2] Dr. H. Forster Morley, *Nature*, 106, 811–13, Feb. 17, 1921.

sions existed, the simple case of the solar field being actually six dimensional,[1] as are also certain other physical solutions obtained by Weyl.

III. The author has found all solutions of $G_{ik}=0$ of the orthogonal form $\lambda_1 dx_1^2 + \lambda_2 dx_2^2 + \lambda_3 dx_3^2 + \lambda_4 dx_4^2$ in which the four coefficients are functions of one variable say x_1. An example of such a field is

$$x_1^{-2}dx_1^2 - x_1^4(dx_2^2 + dx_3^2 + dx_4^2).$$

All cosmological solutions which satisfy the same hypotheses are determined and can be expressed by elementary, algebraic and transcendental functions.

The principal solution is

$$ds^2 = \frac{4dx_1^2}{c^2(1+x_1^2)^2} + \left(\frac{2x_1}{1+x_1^2}\right)^{\frac{2}{3}}\left[x_1^{2\alpha_2}dx_2^2 + x_1^{2\alpha_3}dx_3^2 + x_1^{2\alpha_4}dx_4^2\right],$$

where c is arbitrary and α_2, α_3, α_4 obey the relations.

$$\alpha_2 + \alpha_3 + \alpha_4 = 0, \qquad \alpha_2\alpha_3 + \alpha_3\alpha_4 + \alpha_4\alpha_2 = -\tfrac{1}{3}.$$

These fields can all be represented in flat space of seven dimensions. A paper on this subject has been sent to the *Mathematischen Annalen.*

IV. If we require the quaternary form ds^2 to be the sum of two binary forms, that is the sum of the squared elements of two surfaces, then the only cosmological solution (neglecting the trivial euclidean form) is $ds^2 = x_1^{-2}(dx_1^2 + dx_2^2) + x_3^{-2}(dx_3^2 + dx_4^2)$. This represents a quartic manifold of four dimensions imbedded in a 6-flat. The finite equations are

$$X_1^2 + X_2^2 + X_3^2 = 1, X_4^2 + X_5^2 + X_6^2 = 1.$$

This is apparently the simplest solution of Einstein's equations which has thus far been found, and the first one (beyond the obvious flat and spherical spaces) which in its finite form is algebraic.

EDWARD KASNER

COLUMBIA UNIVERSITY,
NEW YORK

[1] See *American Journal of Mathematics,* Volume 43 (1921), pp. 126–133.

THE PRODUCTION OF ENHANCED LINE SPECTRA BY A NEW METHOD

THE ordinary spark spectrum differs from the arc spectrum in that certain lines are weakened, others are enhanced and new lines appear. In general the more violent the stimulus of the source the more intense are the new enhanced lines as compared to the weakened lines. It is customary to refer to the lines which are the more prominent in the spectrum produced by an arc as arc lines, while those which are enhanced by the spark are known as spark lines and constitute the pure spark spectrum.

Lorenser and Fowler, as well as Sommerfeld and Kossel, have shown that modern theories of atomic structure and radiation leave little doubt that the enhanced lines in the spectrum are due to radiation from atoms that have lost an electron, *i.e.,* ionized atoms; and that arc lines are due to radiation from the un-ionized or neutral atom. The varying facility of producing the enhanced lines of different elements depends, then, on the intensity of the forces which bind the electron to its nucleus and on the energy used in tearing the electron off. For example, no enhanced lines of lithium have ever been produced while the enhanced doublet of calcium, H and K, is strong even in the flame spectrum.

In a study of the enhanced lines of the calcium spectrum begun by examining the spectrum of calcium wires exploded by the Anderson method[1] it was found that as the size of the wires used was decreased, while the energy of the stimulus remained the same, the intensity of the enhanced lines increased. This increase in intensity indicated a more complete ionization of the calcium atoms. In seeking a way by which the amount of calcium in the source could be still further reduced a new source of light was developed.

A fine asbestos fiber about three centimeters long was saturated with an aqueous solution of some salt of calcium. The saturated fiber was fastened in place as the fine wires had previously been fastened and the charge of the high tension condensers thrown across it,

[1] *Astro. J.,* 51, 37, 1920.

as before. The fiber was not injured by the discharge but could be saturated and used again and again. About the same number of discharges as had been employed with the exploded wires produced satisfactory results. For convenience in discussion and because of its character this new light source has been tentatively called the super spark.

An inspection of the calcium spectrum thus produced showed a striking enhancement of the spark lines of calcium over the arc lines indicating that a large proportion of the emitting atoms were ionized. For the purposes of comparison a table is inserted showing for the present work with the exploded wire and super-spark and for the work of other observers with various sources—the relative intensities of the H and K lines of calcium, a prominent spark doublet, and the line 4227, a strong arc line. The ratio of these intensities is, we believe, a fair index of the relative proportions of ionized and unionized emitting atoms in the source.

THE RELATIVE DEGREE OF IONIZATION OF CALCIUM IN DIFFERENT SOURCES

Source	Intensity of H and K	Intensity of 4227	Ratio of Intensities
King's electric furnace	55	1000	1:19
Crew & McCauley arc	400	500	4:5
Lockyer spark	500	400	5:4
Loving vacuum arc	20	8	5:2
Exploded wire	600	150	4:1
Super spark	700	70	10:1
High chromosphere of sun	72	8	9:1
Class B stars	7	1	7:1

This table indicates that there can be produced in the laboratory the same degree of ionization as is shown to exist in the high chromosphere of the sun or in the spectra of the early (or hot) type B stars. The super spark seems to give a more highly ionized source than any yet produced in the laboratory.

The results of an extended study soon to be published of the super spark spectra of calcium and other metals may be briefly summarized here. For the metals studied in the groups one, two and three of the periodic table, an almost pure enhanced line or spark spectrum has been produced. As might be expected it has been impossible to get perfect ionization even in this source and the strongest lines due to the neutral atom still persist. A striking feature of the super spark is the amazingly small amount of material required to produce spectra. By use of a dilute solution of calcium chloride for example there is produced not only the calcium spectrum but also the spectrum of the other metals of the same group: Magnesium, barium, strontium, zinc and cadmium; and generally a few lines of other metals. These other metals could have been present only in minute amounts and yet their spectra rival in intensity that of the principal substance. Another striking characteristic is that practically only metallic lines are produced by the super spark,— the spectra of hydrogen, oxygen or of the acid radical of the salt used do not appear, and only the strongest air lines can be identified.

The super spark, it will be seen, gives a method by which a very powerful stimulus can be applied to any metal that can be obtained in the form of any of its partially soluble salts. It is not even necessary that the metal in question be the principal metallic constituent of the salt. Good results may be obtained for metals which appear only as minor impurities in the salt used.

R. A. Sawyer,
A. L. Becker

Physical Laboratory,
University of Michigan,
August 11, 1921.

THE IOWA ACADEMY OF SCIENCE

The thirty-fifth annual session of the Iowa Academy of Science was held at Simpson College, Indianola, on April 29 and 30. At the opening meeting on Friday afternoon President Knight gave his presidential address on "American science." The Academy divided into sections of botany, zoology, geology, and physics for the reading of papers, and at 5 o'clock adjourned for an enjoyable auto ride given by the Indianola Chamber of Commerce. At 6 o'clock the sections met for group dinners and at 8 o'clock Dr. J. Paul Goode of the University of Chicago, addressed the

Academy on "America as a world power." Following the address President and Mrs. Hillman of Simpson held a reception for the visitors.

On Saturday morning the sections concluded the reading of papers and the Iowa sections of the American Chemical Society and the Mathematical Association of America held their meetings. At the business meeting the constitution was revised to drop the classes of corresponding fellow and corresponding associate. Members are to be classed as honorary fellows, life fellows, fellows and associates. Six sections of the Academy are provided for and the chairmen of these, with the elected officers, constitute the executive committee. An editorial committee is provided for to assist the secretary in preparing manuscripts for publication. Officers were elected as follows: *President*, D. W. Morehouse, Drake University, Des Moines; *Vice-President*, R. B. Wylie, State University, Iowa City; *Secretary*, James H. Lees, Iowa Geological Survey, Des Moines; *Treasurer*, A. O. Thomas, State University; *Presidents of Sections: Botany*, R. B. Wylie; *Zoology*, Harry M. Kelly, Cornell College, Mount Vernon; *Geology*, A. C. Trowbridge, State University; *Physics*, L. P. Sieg, State University; *Chemistry*, P. A. Bond, State University; *Mathematics*, W. J. Rusk, Grinnell College, Grinnell.

The following program was presented:

CHEMISTRY

Further work in the study of free energy of aqueous solutions: J. N. PEARCE and H. B. HART.

The effect of relative positions of the hydroxide and amino radicals in the migration of acyl from nitrogen and oxygen: L. CHARLES RAIFORD and H. A. IDDLES.

A chemical study of dolomites: NICHOLAS KNIGHT.

Twenty-seven specimens were included in the investigation. They belonged to different parts of the United States and to a number of foreign countries. It was found that the term *dolomite* is rather loosely used, as the specimens ranged all the way from fairly typical dolomites to ordinary limestones. Indeed, some of the specimens proved to be quite pure sandstones.

A brief review of the various methods of producing dolomite artificially was included in the paper.

GEOLOGY

Three glacial tills at Ames, Iowa: JOHN E. SMITH. This illustrated paper treats of the character of these deposits and of their relations to each other. The observations were made in a large excavation opened to receive the foundation of Wesley Hall just south of the grounds of Iowa State College on Lincoln highway. At this place most of the Wisconsin till had been removed by erosion prior to the beginning of this work. A zone of red soil separates it near the top of the pit from the Kansan below. Beneath the Kansan which covers a rough, eroded surface, is a third till believed to be the Sub-Aftonian or Nebraskan.

Eolian deposits in Webster county, Iowa: JOHN E. SMITH. The location, distribution and origin of a deposit which overlies the Wisconsin till in this area is discussed in the paper. A typical section shows one foot or more of each of the following which are named in order of their occurrence from the surface downward: *Section:* (1) Clay, gray, with no pebbles. (2) Soil, a black zone of humus with few pebbles. (3) Subsoil, brown, with glacial pebbles. (4) Glacial till, unweathered. The principal question involved concerns the origin of number 1 of the section, which one authority holds to be free from glacial pebbles because of a postulated advanced stage of weathering.

The existing stage of erosion in the United States: ARTHUR C. TROWBRIDGE. Inspection of 398 topographic maps published by the U. S. Geological Survey since 1912, and representing 41 of the states of the Union, reveals no illustration of any considerable area of surface which has been reduced to old age of a cycle of erosion by the work of streams. Old valleys are fairly abundant but no general surface is found which can be said to have been baseleveled or even peneplained. This is interpreted to mean that the present time was so closely preceded by uplift and enlargement of land that there has not since been time for streams to reduce the surface beyond maturity, or at best, beyond early old age. Either the Pleistocene period was too short to permit land uplifted in the latest Tertiary to be greatly reduced—an explanation which seems unlikely to the writer—or there has been Pleistocene or post-Pleistocene uplift.

Some north-south topographic profiles in the United States: ARTHUR C. TROWBRIDGE and JOHN T. LONSDALE. That part of the surface of North America which was not covered by the Pleistocene ice sheets was, during the glacial period, subject to the ordinary processes by which land is de-

graded or renewed. On the contrary not only was stream degradation repeatedly interrupted in the glaciated area, but the surface there was repeatedly eroded glacially, and as many times received glacial deposits. Thinking that these differences in Pleistocene history between the glaciated and unglaciated parts of the continent might have resulted in profiles notably discordant at or near the drift border, a series of meridional topographic profiles was drawn from the Canadian border to the Gulf of Mexico. The results are negative in that no topographic break is shown at the line separating the glaciated from the unglaciated area, but on the whole the surface near the drift border to the south is higher than that to the north. The paper consists of a presentation of these profiles and discussion of several possible interpretations of their meaning.

Interglacial volcanic ash: Charles Keyes. During the progress of extensive street grading in the city of Des Moines, recently, there was disclosed immediately under the Wisconsin till sheet, a white, claylike bed about a foot in thickness. It manifestly did not belong with the drift or the yellow loess beneath. Since the material was too incoherent to be true clay, and was finely gritty, it was examined under the microscope. It proved to be typical volcanic ash, composed of transparent, sharp-edged fragments of glass about one twentieth of a millimeter in average size. The thick loess deposit underneath is underlaid by the Kansan till. This occurrence probably fixes, within very narrow limits, the date of the volcanic outburst, and the age of similar ash beds reported in Nebraska, Colorado and Wyoming.

Erosion of high plateaux: Charles Keyes. The lofty, flat-topped mountain ranges of eastern Utah are usually treated as part of the great Cordilleran uplift. Curiously, they now appear both physiographically and tectonically to be wholly unrelated. Although the repeated uplifting and peneplanation which the Rockies have suffered are appreciably reflected in the Utah field the amount of erosion which the former has undergone enormously surpasses that of the latter. Notwithstanding the fact that both chains of mountains are characterized by remnantal summital flats, the latter seem to be nicely separated in point of time. On the one hand the summital plain of the Rockies appears to be ancient Comanchan peneplain now being exhumed as the Dakotan sandstone is being stripped off. On the other hand the *terre pleins* of the High Plateaux of Utah are referred to the regional planation of Miocene times. In the Cordilleran region these two horizons are stratigraphically separated by more than three miles of sediments. The Jurassic-Comanchan peneplain of the Rockies is strongly reflected so far east as Iowa and Minnesota; as is also the Miocene peneplain of Utah.

Crazing of mountain massifs: Charles Keyes. The central *massif* of the Sierra de los Cucaras, in Lower California, is a granitic type of rock not very unlike that of the Sierra Nevada. Its naturally blue-gray color darkens on exposure, thus bringing out in strong contrast the wonderful veining, which is white. The veining in the vertical walls of the mountain canyons has the appearance of normal jointing set on edge, but on a colossal scale, the cross-planes being filled with pegmatitic materials to a thickness of two to six feet. Towards the north end of the mountain range the titanic crazing is displayed in superb sections 1,500 feet high, in the famous Carriso Gorge, near the United States boundary.

Some Pleistocene sections at Des Moines: James H. Lees.

Some Carboniferous protozoa: Eula D. McEwan.

The status of certain Rynchonellid Brachiopods from the Iowa Devonian: A. O. Thomas and M. A. Stainbrook. The *Rynchonella alta* Calvin from the upper Devonian beds at Bird Hill, Hackberry Grove, and elsewhere in Floyd and Cerro Gordo counties, has been much confused in the literature and in collections with a similar rhynchonellid shell from the State Quarry beds near Solon. In most cases in the Iowa reports the Solon species has been called *Rhynchonella pugnus* or *Pugnax pugnus* (Martin). In some instances the two have been entered under the same specific name and in others the first has been made a varietal form of the second. A study of their internal structures by Mr. Stainbrook shows that each belongs to the genus *Pugnoides.* They are specifically distinct. The more robust but less acuminate State Quarry shell, with a variable number of plications on its fold and sinus, is made a new species, *Pugnoides solon,* and the Lime Creek species becomes *Pugnoides altus* (Calvin). Illustrations.

A Cephalopod from the Coal Measures at Mystic, Iowa: A. O. Thomas. A fine specimen of the goniatite, *Gastrioceras excelsum* Meek, was recently collected by Mr. Ben H. Wilson, a member of the Academy. The specimen came from the Appa-

noose formation at Mystic, Iowa, and is said to have been taken from a shale just below a coal seam at a depth of fifty to sixty feet. The type of this species and one or two other examples came from the Pennsylvanian of Kansas; others are recorded from Arkansas; the specimen here reported is the first from Iowa. Illustrations.

Some Oligocene Brachiopods from the Island of Antigua, B. W. I.: A. O. THOMAS. In the Antigua limestone at Half Moon Bay, Antigua, there occurs an abundance of lepidocycline foraminifera, a number of sea-urchins, some corals, pelecypods, a few gastropods, and rarely some brachiopods belonging to the genera *Argyrotheca, Terebratulina,* and *Liothyrina.* They appear to be new species though the Liothyrinas are close to those reported by Guppy from Trinidad over fifty years ago. These small forms have added interest since very little is known about the brachiopods of the American Oligocene.

Note on a beaver tooth from the Pleistocene at Des Moines, Iowa: A. O. THOMAS. The specimen is an incomplete incisor tooth of the giant beaver, *Castoroides ohioënsis* Foster. It was found by Mr. B. A. Wickham in gravels of uncertain age while making an excavation near the west city limits. This is the third locality record from Iowa, the others being Turin and Oakland. Illustration.

Some proboscidean remains found in Henry county, Iowa: H. E. JAQUES.

The loess fossils of western Tennessee: B. SHIMEK.

PHYSICS AND ASTRONOMY

A laboratory optical pyrometer: Notes on its design and operation: WM. SCHRIEVER.

(1) *Measurements of the amplitude of vibration of the diaphragm of the Hewlett tone generator.* (2) *Determination of the minimum audible intensity of tones of high frequency:* CLARENCE E. LANE.

A low frequency acoustic wave filter: G. W. STEWART.

(1) *The effect of drawing on the crystal structure of tungsten wires.* (2) *A note on Kater's reversible pendulum:* L. P. SIEG.

The coefficient of rigidity, and Young's modulus for hexagonal crystals of selenium: L. P. SIEG and R. F. MILLER.

The absorption of light passing through deep slits, as a function of the length and depth of the slits and of the wave length of the light: L. P. SIEG and A. T. FANT.

The tactual analogy of stroboscopy: L. E. DODD.

Scattering of X-rays in carbon: C. W. HEWLETT.

A new loud speaking telephone receiver: C. W. HEWLETT.

Hall effect in thin films: J. C. STEINBERG.

The Alpha lines in the "K" series tungsten spectrum: CHARLES CROFUTT.

A note on Nova Cygni, No. 3: D. W. MOREHOUSE.

Review of solar observations at Alta, Iowa, during the past thirteen years, 1908–1920: DAVID E. HADDEN.

ZOOLOGY

A study of the nesting habits of the Baltimore oriole: H. E. JAQUES and KATHERINE GILMORE.

Nactarina in the United States: FRANK C. PELLETT.

Corn oil cake meal for growing and fattening pigs: JOHN M. EVVARD.

Notes on the mammals observed in Marshall county, Iowa: IRA N. GABRIELSON.

Bird banding and incidental studies: DAYTON STONER.

Burrows and burrowing habits of the common mole: A. V. ARLETON.

Some observations on certain Cladocera: FRANK A. STROMSTEN.

Alcohols as factors altering fatigue processes in frog muscle: FRANCIS M. BALDWIN.

Analysis of certain smooth muscle responses: B. M. HARRISON and FRANCIS M. BALDWIN.

Notes on the differential viability in Gambusia: S. W. GEISER. Author presents evidence to show that in the shipment of *Gambusia affinis,* the common mosquito fish, the males have a higher death rate than the females, both in winter and summer shipments. He shows by experiments that this higher death-rate is not due to warming of the water in the shipping can, but is owing to other causes. The male death-rate in warm weather shipments is much higher than that of those sent in cold weather; in the females, there is no corresponding increase in the death-rate. He combats the evidence brought forward (1921) by Barney and Anson to show a higher death-rate among the females in shipments of Gambusia.

The distribution of the European elm scale: Albert Hartzell.

Further studies of the relative position of the maxima contractions of the amphibian muscle when subjected to the various ranges in temperature: R. L. Parker.

Cytology of the large nerve cells of the crayfish (Cambarus): L. S. Ross.

The readjustment of the peripheral lung motor mechanism after bilateral vagotomy: T. L. Patterson.

A new Trematode parasite of the Unionidæ: Harry M. Kelly.

Two insect pests on clover: H. E. Jaques.

Methods of teaching parasitology: Herbert R. Werner. (Posthumous.)

Insect parasitism with special reference to parasitic Diptera: Ivan L. Ressler. This paper is a review of the important publications which have appeared since 1602, on insect parasitism, when the exit of the Hymenopterous parasite, *Apanteles glomeratus* L., from the common cabbage butterfly was observed. Parasitism as a factor in insect control is discussed as well as other natural agencies of control. The various families of the Diptera are classified with reference to their predatory or parasitic characteristics. The biology of the Tachinidæ which is probably one of the best known of the parasitic Diptera, is discussed at length.

BOTANY

Notes on the genus Catherinea in Iowa.—I: Lucy M. Cavanaugh. A discussion of variation in leaf-characters in this genus as represented in Iowa.

The use of common names for plants: B. Shimek. A presentation of some objections to the use of "common names" for plants.

A prairie grove in eastern Illinois: B. Shimek. A discussion of an isolated grove on the prairies at Royal, Illinois, and the evidence which it offers towards the solution of the problem of the treelessness of the prairies.

Some noteworthy fungi from South Carolina: Guy West Wilson.

Dr. Rudolph Gmelin and his collection of Minnesota, Wisconsin and Iowa plants: R. I. Cratty. Dr. Gmelin lived for many years practicing his profession as a physician and surgeon at Elkader, Iowa, and other points, and a brief biographical sketch and a list of plants collected by him is presented.

Two additions to our list of Cruciferae: R. I. Cratty. A brief paper on *Brassica juncea* (L.) Cosson, the Indian mustard, and *Lepidium perfoliatum* L., a recent emigrant from the old world.

A brief survey of economic botany: L. H. Pammel.

Studies in the germination of some woody plants: L. H. Pammel and Charlotte M. King.

Some wound responses of foliage leaves: Robert B. Wylie.

Notes on phycomycetes: I. E. Melhus.

A list of some of the phycomycetes in Iowa: J. M. Raeder.

A key to the plant families of central Iowa: Winifred Ellsworth and Henry S. Conard.

Fossil plants and classification: Henry S. Conard.

A study of the vegetation of Austin Bluffs, near Colorado Springs, Colorado: T. J. Fitzpatrick. An intensive study was made of this area during the summer of 1920. As the location occupies an intermediate position between that of the plains on the one side and the mountains on the other its flora is an interesting one.

CHILD WELFARE

Research in the field of mental and physical development of children: B. T. Baldwin and Lorle I. Stecher.

IOWA SECTION, MATHEMATICAL ASSOCIATION OF AMERICA

Correlation between mental tests and grades in mathematics of freshman engineering students: Maria M. Roberts.

Playing with the sine and projection formulas: W. J. Rusk.

Certain summation formulas: John F. Reilly.

Some properties of the function $w = \tanh z$: F. M. Weida.

Derived solutions of differential equations: M. E. Graber.

The surface $z = \log_y x$: C. W. Emmons.

Circles mutually tangent and tangent to concentric circles at specific points: C. W. Wester.

A study of certain reports of the "National Committee on Mathematical Requirements": Committee Report. J. V. McKelvey, *Chairman.*

James H. Lees,
Secretary

SCIENCE

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SCIENCE

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THE SECOND INTERNATIONAL CONGRESS OF EUGENICS
ADDRESS OF WELCOME

I DOUBT if there has ever been a moment in the world's history when an international conference on race character and betterment has been more important than the present. Europe, in patriotic self-sacrifice on both sides of the World War, has lost much of the heritage of centuries of civilization which never can be regained. In certain parts of Europe the worst elements of society have gained the ascendancy and threaten the destruction of the best. At this moment we welcome the sound and highly trained judgment of Major Leonard Darwin, leader of the eugenics movement in Great Britain; of Dr. Lucien March, the leading statistical authority of France, also leader in the eugenics movement and senior representative of the eugenics movement there; of Dr. Lucien Cuénot, foremost student of the science of heredity in France; of Dr. G. V. de Lapouge of France, the leading authority on racial anthropology and earnest exponent of practical eugenic measures by the government. Dr. Jon Alfred Mjøen of Norway is the leader in the vigorous movement of race hygiene in Scandinavia. Contributions are welcomed from other representatives of Great Britain, of France, of Italy, of the new Republic of Czecho-Slovakia, of our sister Republic of Cuba, and of South and Central America. The leading students of heredity, of statistics, of anthropology, and of eugenics in the United States are here to welcome their confrères from abroad.

To each of the countries of the world, racial betterment presents a different aspect. To the five countries most closely engaged in the recent fratricidal conflict, the financial and economic losses of which we hear so much are as nothing compared with the spiritual,

intellectual, and moral losses which each has sustained. In the Scandinavian countries, which kept out of the conflict, and to a large extent in the United States, the case is different. In Scandinavia, which I have recently visited, it is largely through the active efforts of leaders like Mjøen and Lundborg that there is a new appreciation of the spiritual, intellectual, moral, and physical value of the Nordic race, and that a warning is being given that it must not be too severely depleted by emigration. Nearly half that race is now in the United States.

In the United States we are slowly waking to the consciousness that education and environment do not fundamentally alter racial values. We are engaged in a serious struggle to maintain our historic republican institutions through barring the entrance of those who are unfit to share the duties and responsibilities of our well-founded government. The true spirit of American democracy that *all men are born with equal rights and duties* has been confused with the political sophistry that *all men are born with equal character and ability to govern themselves and others,* and with the educational sophistry that education and environment will offset the handicap of heredity. South America is examining into the relative value of the pure Spanish and Portuguese and of various degrees of racial mixture of Indian and Negroid blood in relation to the preservation of their republican institutions.

In my recent tour through Belgium and all parts of France, I was deeply impressed with the very slight convergence produced by 12,000 years of similar environment and a thousand years of similar education upon the three divergent races of which France is composed,—the Mediterranean, the Alpine, and the Nordic.

The constructive spirit of this Congress is to discover the virtues and the values of each of these minor divisions of the human species, as well as the needs of the major divisions, known as the Caucasian, the Mongolian, and the Negroid. The reason that these races are so stable and maintain their original character so stoutly is that the most stable form of matter which has thus far been discovered is the germ plasm on which heredity depends. This outstanding fact of heredity will be brought out in the First Section of the Congress. As a palæontologist and geologist, as well as something of a biologist, I find no form of matter so stable in nature as that on which heredity depends—consequently the selection, preservation, and multiplication of the best heredity is a patriotic duty of first importance. In the selection of the best we should know no prejudice. If we extenuate nothing, we write down nothing in malice. The 500,000 years of human evolution, under widely different environmental conditions, have impressed certain distinctive virtues as well as faults on each race. In the matter of racial virtues, my opinion is that from biological principles there is little promise in the "melting pot" theory. Put three races together, you are as likely to unite the vices of all three as the virtues. This opinion, however, awaits the experimental proof or disproof which will be presented by researches such as those of Doctor Sullivan in the Hawaiian Islands. For the world's work, give me a pure-blooded Negro, a pure-blooded Mongol, a pure-blooded Slav, a pure-blooded Nordic, and ascertain through observation and experiment what each race is best fitted to accomplish in the world's economy. If the Negro fails in government, he may become a fine agriculturist or a fine mechanic. The Chinese and the Japanese have demonstrated in the history of their respective countries a range of ability in art, literature, and industry quite equal to our own in certain arts, and greatly superior to our own in other arts, like ceramics. Let each race consider its own problems and demonstrate its own fitness.

Our Fourth Section is devoted to the state. The right of the state to safeguard the character and integrity of the race or races on which its future depends is, to my mind, as incontestable as the right of the state to safeguard the health and morals of its people. As science has enlightened govern-

ment in the prevention and spread of disease, it must also enlighten government in the prevention of the spread and multiplication of worthless members of society, the spread of feeblemindedness, of idiocy, and of all moral and intellectual as well as physical diseases.

I would not anticipate the findings of any of the four sections into which the work of the Congress is divided, but I would express my opinion that the monogamous family, *i.e.*, one husband, one wife, is to be maintained and safeguarded by the state as well as by religion as a natural and hence as a patriotic institution. In Doctor Lowie's very able recent work, "Primitive Society," it is shown that in general the family is safeguarded; that the natural instinct so widely prevalent among all social lower orders of animals to preserve the family at all costs dominates the elementary morals of primitive races. It is not an exaggeration to say that many tendencies in recent social development, as distinguished from racial evolution, are against this natural mandate regarding the family. The wisdom of British biologists, expressed by Tennyson in his memorable lines:

> So careful of the type . . .
> So careless of the single life,

has been transmuted into the fatal reverse

> So careful of the single life . . .
> So careless of the type.

The closing decades of the nineteenth century and the opening decades of the twentieth have witnessed what may be called a rampant individualism—not only in art and literature, but in all our social institutions—an individualism which threatens the very existence of the family; this is the motto of individualism: let us obey our own impulses, let us create our own standards, let each individual enjoy his own rights and privileges—for tomorrow the race dies. In New England a century has witnessed the passage of a many-child family to a one-child family. The purest New England stock is not holding its own. The next stage is the no-child marriage and the extinction of the stock which laid the foundations of the republican institutions of this country.

It is questions of this kind which are being set forth before this Congress so that they may be disseminated among our people. Let us endeavor to discard all prejudices and to courageously face the facts. Recent works by Bury and Inge on human progress are regarded in some quarters as pessimistic. I do not regard them as pessimistic, because to my mind the pessimist is one who will not face the facts, and these writers, especially Inge, look at the worst as well as at the best. I regard an optimist as one who faces the facts but is never discouraged by them. The optimist in science is one who delves afresh into nature to restore disordered and shattered society. This was the constructive spirit of Francis Galton, founder of the science of eugenics. I trust it will be the keynote of this Congress. To know the worst as well as the best in heredity; to preserve and to select the best—these are the most essential forces in the future evolution of human society.

HENRY FAIRFIELD OSBORN

THE AIMS AND METHODS OF EUGENICAL SOCIETIES

INTERNATIONAL CONGRESSES are organized no doubt mainly with the object of enabling workers in the same field both to become personally acquainted with each other—a far-reaching benefit—and to exchange information and ideas. We who have just crossed the Atlantic have come to a land in which many notable institutions have long been engaged in the study of biology and genetics, these being the pure sciences on which the applied science of eugenics is based, and where human racial problems have also long been keenly investigated. So much has been done in all these directions here that when I was honored with an invitation to address you I felt great difficulty in selecting a subject which I could discuss with any reasonable prospect of promoting our common aim, namely the improvement of the racial qualities of future generations. It is, however, not only scientific information

which we can now profitably exchange one with another, but also our actual experiences; and, as I have been for ten years president of a British society for the promotion of eugenics, it occurred to me that it might interest you to hear something about our aims, our methods and our difficulties. I look forward to the time when eugenical societies will exist in all populous centers, their work being to strive to build up a social superstructure on the scientific foundations laid by central organizations engaged in biological and eugenical research. Whilst these much needed societies are passing through the period of their adolescence, we may be sure that they will not be without their growing pains and their difficulties; and these difficulties will certainly be more easily overcome if clearly realized in advance. I hope, therefore, that existing societies will not scruple to air their troubles in public!

When an association is being created with any social object in view, a demand is likely to be made for a clear and rigid definition of the policy which is to be promoted by it; and from such demands may arise not only the first juvenile ailments of eugenical societies, but also occasional internal inflammations later in life. Now I was recently asked to state once again in broad and general terms what are the aims of my society, such a statement being needed not so much for our own information as to enable us to make our position more clear to the general public. The main difficulty in replying to this request lay in the fact that experience has taught us that attempts to decide in detail exactly what may be advocated and what should be condemned by eugenists are more likely to do harm than good by unduly restricting eugenic activities. A choice has always to be made between a smaller society with narrower aims and a larger society tolerating wider divergences of opinion; and although both plans have their advantages, yet in a young and growing subject like eugenics care should be taken not to injuriously hamper future liberty of action by too rigid definitions of policy. What seemed to me to be needed was a eugenic sign post, with arms pointing, not to every by-path, but to the various main roads along which our society should strive to advance; and the conclusions I then reached I now repeat in the hope that they may prove to be of some interest to a wider circle of friends.

The first words which I uttered as the president of my society ten years ago were that heredity should be its guiding star, and in that opinion I have never faltered. A good deal of progress has been made since that date, and now the man who calls himself well educated is as a rule beginning to have some dim idea that all human beings are the product of two factors, heredity and environment, and that consequently to both of them some attention should be paid. Now if a eugenical society accepts only one of these factors, namely heredity, as the foundation on which all its operations ought to be built, its members should as individuals most clearly emphasize the fact that all those who are striving to improve human surroundings have their warm sympathy. Of course eugenists cannot approve of such measures as would injure mankind as a whole, the future as well as the present being taken into account; but, putting that possibility aside, we personally should give our blessing to many reforms which eugenical societies do not help to promote. We see as clearly as anyone that to take steps tending to produce in the future a race with the best possible natural qualities would be a futile proceeding unless we hoped that when such a race did appear great care would be taken to give to it good surroundings. If eugenical societies confine their attention exclusively to heredity, it is only because so many other societies think only of environment.

It is true that sometimes it may be necessary to indicate that the high hopes entertained by reformers of to-day are not justified by past experiences. It may be said with only a microscopic divergence from the truth that all reforms since civilization began have been based on attempts to improve human surroundings; and we may ask those who found their hopes for the future only on changes being made in environment to consider how much has thus been accomplished since history began. As to our highest moral ideals, is it not true that for

the most part they have been promulgated in certain eastern countries ever since the dawn of civilization? How do we compare in intellect with the inhabitants of ancient Greece two thousand years ago? With a knowledge of the delights of country life, can we look on our slums with anything but shame? Do we not blush to talk of peace on earth and goodwill towards men whilst remembering what has happened during the last seven years? And, in view of all this, have we any right to assume that improvement of environment will do more for mankind during the next two thousand years than it has done since the days of Plato? Reformers who look only to surroundings should consider well the foundations on which their projects are based before pointing the finger of scorn at the believers in heredity. Eugenics has been called a dismal science, but it should rather be described as an untried policy. Eugenics indicates a new method of striving for human welfare which, if combined with an equal striving for improvements in human surroundings, more truly justifies a hopeful outlook than anything which has yet been tried in the whole history of the world. More hopeful, that is, if the roads to which our eugenic finger post is pointing are not as studiously avoided in the future as they have been in the past.

The eugenic signpost which we wish to erect should, in my opinion, have three arms on it, pointing to three main lines along which an advance should be pressed forward. In the first place the public should be made to realize more and more fully what a potent influence heredity has on the fate of all nations. In the second place efforts must be made to ascertain and to make known the rules by which each individual ought to strive to regulate his own conduct in regard to parenthood in accordance with the laws of heredity in so far as they are now surely known. Lastly, the action which the state should take in order to stimulate and to enforce conduct productive of racial progress must be considered, a line of advance to be advocated, however, with great circumspection when compulsion is concerned. Our aim must be to advance along all these three roads simultaneously and continuously.

The laws of natural inheritance supply a means of predicting in a measure the qualities of offspring when the qualities of their parents are known; and if any society accepts heredity, not as its sole guide, but as a light ever to be held in view, it is in fact intending to rely to some extent on these laws of natural inheritance when attempting to forecast the results in the future of our actions of to-day. Genetics is the pure science which deals with heredity, and genetics is, therefore, the very foundation on which the superstructure of eugenics is being built. The students of genetics will, however, I am sure, all agree that a vast amount of research is needed before they will be able to rest satisfied with the knowledge they have acquired, supposing it to be possible that such a state of contentment will ever be reached. Now it is impossible to conduct the needed breeding experiments on human beings, and genetic research must be largely concerned with the lower animals and with plants; whilst eugenics is primarily concerned with man alone. Then again eugenics must include the study of many social and economic problems which lie quite outside the sphere of genetics. The pure science of genetics and the applied science of eugenics do, therefore, cover different fields, though the boundary between them is ill defined and movable ; and in both fields further advances are urgently needed. For these reasons it seems to me—though here opinions may differ somewhat—that the main aim of eugenical societies should now be, whilst leaving geneticists to cultivate their own ground, to formulate a sound eugenic policy based on existing genetic knowledge, and then to promote the translation of every advance in eugenic theory into general practise. If we eugenists rely on scientific experts for the laying of our scientific foundations, then we shall be able to devote our main energies to the advocacy of reforms tending to promote racial progress and to considering how wide may be the area over

which such reforms can be justifiably extended.

With regard to much of the research work which is so urgently needed, most eugenical societies will indeed have no option but to leave it to others or to leave it undone; because in many lines of enquiry a well equipped laboratory and a highly skilled staff are essential for success. Certain investigations, which need no special apparatus, however, could be carried on anywhere. Moreover, the scientific material as received from geneticists often needs to be thoroughly discussed by eugenists in a scientific spirit before being applied to human affairs; and we must not rely wholly on genetic research for the supply of scientific material on which to build. Wealthy patriots in all countries will doubtless from time to time perceive that by their wealth they might help to promote the acquirement of that knowledge on which racial progress must depend in the future. A strong central society might in such cases play a useful part in suggesting various directions in which, with their aid, advances of great value could at once be made; as well as being ready, if so desired, to act as agents by whom the investigator would be selected and employed, care being taken not to hamper him with undue control. The more liberal the benefaction the more fundamental and far-reaching might be the researches thus undertaken, and the greater the ultimate benefit to mankind. Your endowments in America are so magnificent that you may not fully perceive how much they are needed elsewhere.

As to the first of the suggested lines of advance, namely, as to getting into direct and immediate touch with the public with the hope of spreading abroad a general knowledge of the laws of natural inheritance, this knowledge should form the basis of all the arguments brought forward at public lectures on eugenics, that is, at lectures not forming part of any extensive series. It is indeed in laying this foundation of scientific truth that speakers on such occasions encounter their greatest difficulties; for many prejudices arising from ignorance have to be overcome. For example, those who do not acknowledge to themselves that men differ greatly from each other in their inborn qualities, cannot be made to realize the extreme importance of paying attention to heredity in regard to social questions; and the acknowledgment that we do not start even in the race of life will be hindered by a disinclination which we all feel both to regard any human disabilities as being incurable and to own that other individuals may be greatly superior to ourselves. As to the facts on which the scientific theories of heredity are based, it is worse than useless to attempt to give them in detail at single lectures; for lecturers should remember that on such occasions they cannot hope to do more than leave an enduring *general* impression on the minds of their audiences. Except in systematic courses of study, much must always be both stated and accepted on authority; for to fully justify all the beliefs of eugenists would require months rather than days. "It is hardly possible," so my father declared, "within a moderate compass to impress on the minds of those who have not attended to the subject, the full conviction of the force of inheritance which is slowly acquired by rearing animals, by studying the many treatises which have been published on the various domestic animals, and by conversing with breeders."[1] If this be so, the public can only learn how to give to natural inheritance its proper value by acquiring information at second hand; and yet to make any statement acceptable to audiences, it must be in some degree endorsed by their own reasoning powers. It is on this account that allusion to the breeding of domestic animals becomes almost a necessity in public lectures on eugenics, for the wisdom of attending to breed in the case of cattle and dogs is universally admitted. Great care should, however, always be taken to indicate that, though our experiences in the stockyard enable us better to understand the laws of natural inheritance, yet our reliance on these

[1] "Animals and Plants under Domestication," Darwin I., pp. 447–448.

laws carries with it no implication whatever that the methods of the animal breeder ought to be introduced into human society. It should in fact be most strongly emphasized that nothing which we advocate is contrary to the highest religious ideals. This is, however, rather a digression; for I am not here to instruct lecturers how to lecture. All that I now wish to insist on is that, by means of lectures to audiences of all kinds, the endeavor to spread abroad sound impressions concerning the force of natural heredity and the enormously important influence which it has in deciding the welfare and the destiny of nations should form a prominent part of the programme of all eugenical societies.

The title selected for the British Society by its founders was the Eugenics *Education* Society, and certainly they had excellent reasons for thus emphasizing the educational aspects of the eugenic campaign which they were inaugurating in my country. No class of the community is more important to interest in racial problems than teachers of all grades; because the ideas of the youth of to-morrow will depend so largely on the opinions of the teachers of to-day. But teachers must be taught before they can take a thoroughly intelligent interest in racial questions; and for this reason it is of primary importance that biology should be given adequate recognition in the curricula of all colleges where teachers are trained. Our educational aspirations could not, however, be completely satisfied in this way; for to finally succeed in the first of our main aims, namely, the spreading abroad of a general knowledge of the laws of natural inheritance, natural science must be given a far more prominent place than at present in the courses of studies of all schools and colleges. No doubt there are many who now regard our efforts with great distrust; but those who feel thus should remember that the better and the more widespread the teaching of biology, the more certain would it be that any eugenic errors would be detected and their harmful influence prevented. Moreover, if we want progress in scientific research to be both rapid and on right lines, it is important that a considerable number of students should be thoroughly trained each year in genetics, or that more undergraduates should specialize in natural science at our universities than at present. Eugenics has a long struggle before it, and all these methods of laying educational foundations for future progress should certainly come within the scope of the efforts of eugenical societies.

Passing on to the second of the main lines along which eugenical societies should strive to advance, what we want to know is the rules which ought to guide each individual in deciding on his own voluntary actions in all matters relating to racial progress. The attempt to ascertain the precepts by means of which each one of us should strive to regulate his conduct in questions connected with parenthood obviously involves the consideration of a number of ethical, racial and economic factors; for, in regard to any proposed line of conduct, we have to weigh in the balance as well as we can its moral effects, the immediate material advantages or disadvantages to the family and to the state which are likely thus to arise, and the benefits or injuries which it will confer or inflict on the race in the future. Even if these problems be approached in a calm and scientific spirit—and in this respect eugenical societies should strive to set a much needed example—even then it will be exceedingly difficult in most cases now to arrive at precise conclusions. We must not attempt in the present state of our knowledge to lay down rigid rules of conduct, but only to suggest general guiding principles; though we may hope that with every advance of science it will be possible more and more clearly to indicate what each individual ought to do and what he ought to avoid. As an illustration of the difficulties involved in these problems, consider the case of a contemplated marriage when both families thus to be connected are characterized by some degree of ill health. Now it would only be persons endowed with high moral qualities who would be likely to obey any self-denying ordinance in regard to mar-

riage and whose fertility would, therefore, thus be diminished. Might we not, by condemning marriage in such cases, tend to breed out the most valuable of all human attributes, namely, the desire to do right? Again if insanity were the family trouble in question, this being one of the most grievous of all human ailments, we now know that it is sometimes the result of disease and probably in such cases not heritable, whilst other types certainly do run in families. What are we to do in the face of such doubts and difficulties as these? Are we to admit our incapacity to meet the situation? Certainly not, for the history of scientific research clearly proves that what to-day appears like an impenetrable barrier to further progress will probably tomorrow be regarded rather as a useful stepping stone for a further advance. Doubtless we have difficulties ahead of us, which must be faced with patience; but we should take note of these obstacles in our path mainly as emphasizing the need for societies where such guiding rules for voluntary conduct in relation to parenthood as are warranted by existing knowledge and by present needs will be wisely and temperately discussed.

A comparatively new subject like eugenics is apt to arouse prejudices and to give opportunities for misapprehension; and it sometimes seems that what is now most needed on the part of eugenical societies in regard to voluntary actions is that they should make clear what they are *not* recommending. We have been accused of wishing to abolish love altogether as a guide to conduct; but this is false. What we desire is rather to purify love, or to clear away all those harmful influences which so often attach themselves to it. Certain American investigations indicate that the ideals which naturally dwell in the minds of young people in regard to the qualities of the mates to whom they would wish to be connected in marriage are on the whole fairly sound, and that these promptings if followed would generally lead to unions beneficial to the race. But the desire for wealth, the wish to rise in the social scale, and, some would add, too great attention to personal appearances, often make the choice of a mate far worse than it would have been if these natural ideals had been given full sway. In passing I must, however, put in a racial plea for good looks on the ground that they are apt to be associated with good health; a plea which I hope does not spring from a mere masculine weakness on my part. Be that as it may, love is doubtless to a large extent aroused by advantageous moral and mental qualities; and, in so far as that is the case, it forms the firmest foundation on which to base a eugenic policy. Much can be done to help to lay this foundation by promoting suitable opportunities for the meeting of young men and maidens; by judiciously encouraging intercourse between our children and worthy friends of the other sex, from amongst whom worthy mates are not unlikely to be selected; by stimulating a pride of family in so far as dependent on character and performance; and, above all, by fostering the growth of all that is noble in the ideals of the adolescent. Never make a close friend of a person one can not respect is, I believe, not only a helpful rule of life, but also a useful way of setting an example to the rising generation. But here a possible racial danger must be noted; for an injudicious pursuit of the policy here suggested might make the high-minded become too particular and therefore less likely to marry than their more ordinary companions, with obvious dysgenic consequences. Pure love between the sexes should be proclaimed as the noblest thing on earth, and the bearing and rearing of children as amongst the highest of all human duties. Some risks ought to be run in order to secure these joys and to fulfil these duties; and Cupid may well remain a little blind to all minor defects. To promote these ways of regarding sexual problems and to show how often the moralist unknown to himself is in effect striving to better the racial qualities of future generations come well within the scope of our endeavors.

Though we have seen that as knowledge increases so the difficulties of deciding on rules of personal conduct will diminish, yet it is certain that these difficulties will ever remain very

formidable. We may now boldly assert that when the heritable defects of many members of a family are very serious, those belonging to it should not become parents; but how serious must these defects be before being regarded as a bar to parenthood? It will never be possible to draw as sharp a line of demarcation as that between sheep and goats when marking off from the general population those in whom parenthood would be a moral offense. Because of this impossibility, it may come to be held that the size of the family should vary with the innate qualities of the parents; but how is this relationship between fertility and transmissible characteristics to be determined? Then, again, many who take no thought concerning racial questions now hold strongly that it is wrong to bring a child into the world without a reasonable prospect of its being able to live a life up to a certain standard of civilization. But what should be the standard adopted? In large numbers of cases the cause which has prevented the winning of a "standard" livelihood, however we may define that term, has been some inborn defect, or defect which would in a measure be passed on to the next generation. Teach those not living up to standard to regulate their conduct with due regard to the welfare of any children who may or may not be born in the future, and many would limit their families on this account; with the results that these harmful innate defects would appear less frequently in future generations. Is it not, therefore, of great importance that some attempt should be made to ascertain what standard of living does justify parenthood? Again it is even more important that it should be widely felt that it is morally wrong to limit unduly the size of the family when parents are up to "standard" in all respects; for it is essential for the welfare of mankind that the seed of this good stock should not be lost to posterity. Eugenical societies should, in my opinion, steadily keep in view the necessity of trying to solve all these intensely difficult problems; problems which need the joint consideration of the eugenist, the geneticist, and the economist for their solution. But as for our advice of to-day concerning personal conduct in regard to procreation, we can say little more than that moral principles must always be kept in the foreground, and that, for the rest, trust must be placed in common sense and a wise doctor.[2]

To whatever extent success may attend our efforts to lay down rules for personal conduct in regard to parenthood, to that extent we shall have succeeded in deciding on the directions in which we wish to advance in these matters. Such decisions will, however, prove to be but a very uncertain indication of the extent to which the state should endeavor to promote or to enforce obedience to these rules; this being the subject to which we must now turn our attention. By promoting uniformity of conditions and by checking individual initiative, the state often retards progress; and, besides affecting those intended to be affected, governmental action nearly always produces on other persons various consequences which were unforeseen and which are never fully realized. Whatever may be our political opinions, we nearly all of us agree that these are dangers which must be taken into account when contemplating state control over the individual. These are, however, large issues which some will regard as lying outside the proper scope of eugenic considerations; whilst the point which I especially wish to emphasize in this connection is one definitely related to the actions of eugenical societies. In my opinion our societies ought to be ready to encourage *discussion* on all proposals for relevant reforms, whilst they should be cautious in the present state of our knowledge in actually recommending *governmental interference*. If discussion be not bold, progress will be slow; for a nation can not grope its way quickly to the front in the darkness of ignorance. If action be too bold, progress will also be slow; for the wrong road will often be taken. In matters of conduct we should balance the *probability* of good or evil arising from the action proposed to be taken, as against the *magnitude* of the good or evil if it does arise. The smaller the chances of failure, the smaller may be the benefits hoped to be

[2] I assume that the doctor has studied genetics, which is unfortunately not always the case.

attained. The probability of harm resulting from the mere discussion of any reform would usually be very small, even if that reform would be very harmful if adopted. On the other hand, the possibility of benefits arising from the discussion of reform is almost equally obvious whether the proposed legislation would in fact be beneficial or harmful. To take a single example, there are strong differences of opinion as regards sterilization; but all may hold that by open discussion true conclusions would most likely be reached. The advocates of sterilization of course wish to have this subject brought to the notice of the public; whilst its opponents must admit that they will be more likely to promote than to retard its introduction by, as it were, burying their heads in the sand like the ostrich and by refusing to favor the creation of opportunities for openly stating their objections to it. It is indeed nearly true to say that every subject may be openly discussed with advantage *provided the occasion be properly chosen;* and it is in this spirit that eugenical societies should, in my opinion, conduct their proceedings.

In all human affairs we are constantly being compelled to take opposing considerations into account and to adopt compromises, and I think that I ought not to be accused of inconsistency if I now turn round and show why eugenical societies ought not to be too timid in regard to legislation. As to your middle-aged Anglo-Saxon, and I am only speaking for my own country, there is hardly anything which he dislikes so much as having to change his opinions; and from this weakness men of science are by no means exempt! Here is a barrier which will stop any half hearted advance on the part of eugenic reformers! To the students of natural sciences, at all events, we can suggest that Nature's plan seems to have been to stamp out of existence all organisms which fail to fill the places she assigns to them, and this without regard to the sufferings thus caused or to the superiority in many respects of large numbers of the individuals thus eliminated. By adopting rational methods in human affairs, much can be done and much ought to be done to prevent human beings from being enforced to sufferings similar to those which animals in the wild have to endure because of that struggle for existence to which they must submit; but nevertheless we should not be quite blind to the example set us by Nature in her readiness to sacrifice the individual for the sake of the race. Unfortunately it will be our politicians who will mainly settle how far the teachings of science shall be made to affect legislation; and this they will be apt to do with little reference to the opinions of experts and largely in the hope of catching votes. But the votes of future generations can not now be caught, and their interests will, therefore, be likely to receive but scant attention in all democratic countries. Governments which depend on the suffrages of the people are of necessity always somewhat timid in regard to unpopular reforms; and until eugenics becomes popular—when will that be, I wonder!—there is not the slightest chance of eugenic reform moving forward with too rapid strides. Eugenists must lead the advance in racial questions, and our societies must remember that nothing is more fatal to leadership than a show of timidity. We should discuss long and freely, and when we do advance, advance boldly.

Legislative reforms can seldom be effectively promoted or steadfastly maintained unless they are sanctioned by the general opinion of the citizens concerned; and, on somewhat similar grounds, eugenical societies would be wise to avoid taking corporate action in regard to legislation unless the proposal in question has the nearly unanimous approval of their members. The neglect of such warnings has led to the disappearance of governments and to the disruption of societies! When legislation does not involve compulsory interference with the liberty of the individual, there is comparatively little danger of internal friction being caused by its advocacy; for unanimity in such circumstances is both more probable and less necessary than when compulsion is involved. As examples of legislation of general application producing beneficial racial effects, certain reforms in regard to taxation might be mentioned. My

Society took an active part in the agitation in favor of such alterations in the assessment of income tax as would make the burden of taxation fall less heavily on parents of families and more heavily on bachelors and the childless *in the same stratum of society,* the object being to increase the birth rate of a useful class of the community. As to legislation involving interference with individual liberty, here also unanimous support can be obtained if the racial advantages are sufficiently obvious. For example, there was no dissension whatever in my society when we moved in favor of the Mental Deficiency Bill, a bill which authorized the segregation of the feeble in mind, that is to say, their detention in comfort under carefully safeguarded conditions. But until unanimity in the ranks of a eugenical society in regard to such compulsory measures is obtainable, their discussion only is to be recommended. Personally I should like to see practical steps at once taken for lessening the fertility of habitual criminals, of hopeless wastrels, and of the grossly unfit generally, and others doubtless wish to advance in other directions; but we must have patience. My object for the moment is not, however, to attempt to survey all the roads by which advances may be made in future, but rather to consider what should be the broad principles of strategy which should guide eugenical societies in the long fight before them in their attempts to promote racial progress.

Thus I have dealt with the *objects* which eugenical societies should strive to attain rather than with the *methods* of attaining the ends desired, the reason being that I have little novel to suggest in regard to methods. With the view to the advancement of scientific knowledge and the elucidation of eugenic problems, my society holds periodical meetings at which addresses are delivered or questions debated. In our *Review* these addresses are often published, and we there also try to give impartial accounts of current eugenic literature. We maintain a library, and give advice to readers. We keep in touch with foreign societies, and it has been an especial pleasure to us to give all the assistance in our power to the American committee which has so admirably organized this Congress. As to activities definitely undertaken for the purposes of propaganda, the following may be mentioned: the delivery of lectures to audiences of various types, including social clubs, debating societies, educational conferences, summer schools for teachers, and, during war times, soldiers in camp and barracks; the organization of summer schools dealing largely with eugenics; the sending of deputations to government departments; and of letters to the press. To take one example in detail, after a thorough enquiry concerning the incidence of our income tax, a letter was written to all members of Parliament, and at a later stage amendments to the Finance Act were proposed by members at our suggestion, and were rejected! The next step, a direct result of this agitation, was the appointment by the government of a royal commission on the income tax before which I gave evidence on behalf of my society. Several of the recommendations of that commission, representing a step forward in the direction desired, were subsequently adopted and became law. Thus by steady persistence on well thought out lines a society may be able to produce material effects in many directions. As a last word about the doings of my own society, I must be allowed to mention a dinner followed by an address, held on February 16 in each year. In this way we yearly remind ourselves on the birthday of Sir Francis Galton that to him we owe the opening of the eugenics campaign in England.

What I have tried to do in my address today has been to give some indication of the difficulties likely to be encountered by youthful eugenical societies; difficulties which, we have seen, may come from many quarters and in many shapes. Questions connected with both sex and personal liberty have to be dealt with by eugenists, and these are topics especially liable to give rise to strong feelings. Even when the opposition thus aroused is quite unreasonable, we should, however, always remember that the sentiments underlying this opposition are often in many respects highly commendable, and that to openly

acknowledge where others are in the right is often the best way of getting a hearing for ourselves. The most formidable foe we have to meet is ignorance; and here again it is wise to admit that the ignorance is not all on one side. With every growth in our knowledge of biology and sociology we shall be able safely to enlarge our programme, and we should make it clear that our discussions of to-day are often tentative and do not always indicate the directions in which we shall advance to-morrow. As to the ignorance of our opponents, it can only be overcome by patience, perseverance and above all by never concealing such doubts as are still felt. Unfortunately it must be admitted that even perfect knowledge, however widely held, would not make our path quite smooth, human nature being what it is; for the want of attractiveness of our programme is largely due to the fact that we are looking to human welfare in the more or less distant future and not to present-day comforts. Most men in their march through life are hoping either for personal distinction as a reward for their exertions or for quick returns on their investments; and neither of these benefits is to be obtained in the eugenic market. You can easily enough get your forests cut down and the timber sold for an immediate profit; but the planting of slow growing trees, which will not be worth felling till most of us are dead, is a less attractive venture, though more beneficial to the nation. The reforms which the eugenist wishes to plant would certainly bear excellent fruit in due course, even though much of it would only be gathered by our children and our children's children. Then again your business men not seldom try to sell their goods by running down the wares produced by their rivals, an inexcusable proceeding in so far as merely an outcome of greed and jealousy. Now this same competitive spirit is far too much felt in social work, and I fear we eugenists have often aroused opposition by unnecessarily running down reforms dependent on changes in environment. Let us rather strive to show that there is plenty of open ground over which reformers of all kinds can strive to advance simultaneously and harmoniously; and let us all recognize that jealousy is one of the commonest and probably the most insidious of all human failings. The claims of this generation and of posterity are doubtless sometimes antagonistic, and the genuine difficulties thus arising must be openly faced and often met in a spirit of wise compromise. The main obstacles to be overcome by eugenists are, however, dependent on moral failings, and what we have to show is that we are engaged in a moral campaign, with human welfare in the highest sense as the goal for which we are striving.

Eugenics aims at increasing the rate of multiplication of stocks above the average in heritable qualities, and at decreasing that rate in the case of stocks below the average. But if the banner under which we are to fight should only have inscribed on it some such arid definition of policy as this, our defeat would be certain. We must prove that we are under the guidance of a noble ideal. We of this generation are responsible for the production of the next generation and, therefore, of all mankind in the future; and all in whom this sense of racial responsibility acts as a deep-seated sentiment, greatly affecting their action and their policy, are in truth guided by the eugenic ideal. The belief that man has been slowly developed from some ape-like progenitor came towards the close of the last century to be nearly universally held by thoughtful persons; this belief gave rise to a new hope that this upward march of mankind might be continued in the future; and out of this new hope sprang the eugenic ideal. This growing understanding of the past history of the world has led us to see that, if we are to imitate Nature in her methods, we must be content to advance by means of a long succession of small steps; just as rain falling in drops on the earth has slowly carved out mighty valleys in the hardest rocks. Without constructing wild Utopias, we must be content if some little racial progress can be ensured as each generation succeeds another; for to work in this spirit is to work in harmony with the knowledge which gave birth to the eugenic ideal. Progress on eugenic lines will

make mankind become continually nobler, happier, and healthier; whilst those who imagine that our sole aim is to make man a stronger animal or a better beast of burden are utterly ignorant of the meaning of the eugenic ideal. But science, whilst giving us good grounds for hope, also issues a grave warning concerning the danger of national deterioration resulting from the unchecked multiplication of inferior types. In the past many nations of the first rank, when apparently advancing without check on the path of prosperity, have begun to decay from unseen causes, and have in time so fallen from their high estate as to cease to count as factors making for progress. A determination that such a downfall shall not be the fate of his nation is a sentiment felt by every man who is animated by the eugenic ideal, an ideal to be followed like a flag in battle without thought of personal gain.

Leonard Darwin

FREDERICK MORTON CHAMBERLAIN

Frederick Morton Chamberlain died on August 17, 1921, in a hospital in Oakland, California, after a long and sometimes hopeful fight against tuberculosis. He became seriously ill in July, 1913, while on the Pribilof Islands, and although he partially regained his health for short periods, he was at no time thereafter able to resume his usual activity. The U. S. Bureau of Fisheries has thus lost one of its most faithful employees, one whose clear, keen mind and charming personality will long be mourned by his associates.

Mr. Chamberlain was born in Indiana, June 29, 1867. He graduated at the State Normal School at Terre Haute in 1894, the State University at Bloomington in 1896 and the George Washington School of Law in Washington, D. C., in 1913. A close friendship began at the Indiana colleges with (then) Professor Barton Warren Evermann with whom later he was associated in many scientific investigations.

In the fall of 1896 he followed Dr. Evermann to the U. S. Bureau of Fisheries (then the United States Fish Commission) with which he was connected throughout the remainder of his active career. In 1897 he and Dr. Evermann carried on fishery investigations in some of the southern states. Later in the same year he joined the Fisheries Steamer *Albatross* and accompanied her to Alaskan waters for a season of work in the fisheries. The two following years the investigation of salmon in the streams of California occupied his attention. In this he was associated with Cloudsley Rutter. In 1900 and 1901 he was back on the *Albatross* engaged on Alaska fishery problems, and in 1902 he worked in Hawaii.

During the summers of 1903, 1904 and 1905, a work on the life history and young stages of Alaskan salmon was completed. The report which was published in the Report of the Commissioner of Fisheries for 1906, marks the beginning of an epoch in the study of these important food fishes, and its importance has only lately come to be realized in fish-culture. The clear, concise language shows the hand of the master workman, and the thoroughness with which each problem was attacked is the chief mark of the true scientist. His health failed in 1905, while he was in the field on these investigations, but apparent full recovery was made after a short stay in Arizona.

The *Albatross* sailed on a winter cruise to the south Pacific for Alexander Agassiz during the winter of 1904 and 1905 and Mr. Chamberlain accompanied the vessel as naturalist. The summer of 1906 was spent with the ship in north Pacific and Japanese waters, while from 1907 to 1910 he was in the Philippines. The last cruise closed his connection with this famous vessel. During her most active period Mr. Chamberlain was aboard and attended to the preparation of a great many thousand specimens of marine animals for later examination of specialists. The impersonal manner in which the records of the *Albatross* must necessarily be kept is regrettable. Thus some pieces of iron, fastened together in the form of a ship and named after a bird will live for centuries in the annals of science but the guiding hand which caused the machinery to produce the treasures of the deep, passes to oblivion, unmourned except by his

circle of personal friends. Mr. Chamberlain was instrumental in the bringing to the surface many hundreds of strange new mollusks, crustaceans and echinoderms, yet apparently his name has not been bestowed upon a single one. Two fishes and an Alaskan bird, however, have been named for him.

During the seasons of 1911 and 1912, Mr. Chamberlain filled the position of Alaska salmon agent and worked in the northern territory. In 1913 he was appointed naturalist of the Fur-seal Service and reached the Pribilof Islands just three days before the severe attack from which he never fully recovered. He was conveyed to the states, desperately ill, and the climate of Arizona again helped to only a partial recovery.

G. Dallas Hanna

Museum,
California Academy of Sciences

SCIENTIFIC EVENTS

MOVEMENT OF THE POPULATION IN THE GERMAN EMPIRE

During 1919 and 1920, according to data recently published by the government statistical bureau and quoted in the *Journal* of the American Medical Association, the number of marriages in the German empire exceeded, by a considerable margin, the figures for the prewar period. In the five years from 1914 to 1918, inclusive, almost half a million marriages less were contracted than would normally have been the case. However, this notable falling off in marriages during the years of the war was compensated for, in the main, during 1919 and 1920; for in these two years the number of marriages reached the high figures of 842,787 and 851,508, respectively. Whereas in 1913 there were only 7.7 marriages to 1,000 inhabitants, in 1920 there were 14.8. Normally, forty marriages to 1,000 inhabitants could have been expected during the five years of the war, but, instead, only 25.1 marriages were entered upon. Eighty-two per cent. of the decrease has been made up during the last two years.

In 1914, the number of children born was 1,830,892. In 1915 it had fallen to 1,040,209 and in 1917 to 939,938. In 1918 the number had risen again to 956,251. In place of the normal 8,950,000 births in the period from 1914 to 1918, we find only 4,550,000 recorded, which signifies a loss of 4,400,000 due to the war. In 1919 the total number of children born was still about 400,000 below normal. Not until 1920 was the number of births again about normal, the records showing 1,512,162 births, or 27.1 to every 1,000 inhabitants, as compared with 1,707,834 births, or 28.5 per thousand inhabitants in 1913. The number of deaths in 1920 was 888,795, 16.3 deaths to every 1,000 inhabitants, the mortality for 1919 having been 16.1 per thousand. The last year before the war (1913) showed a mortality of 924,919, or 15.8 per thousand inhabitants. Especially during the first three months of 1920 the mortality rate was very high. More particularly, diseases of the respiratory organs and influenza exacted many victims during this period. In Berlin, more than a third of all deaths, namely, 37.7 per cent., were due to diseases of the respiratory organs, whereas during the first quarter of 1913 only one seventh of all deaths in Berlin were ascribable to such causes. During the last three quarters of 1920, the mortality rate fell considerably, having been 14.9, 14.5 and 15.4 per thousand inhabitants, as against mortality rates of 19.9, 22.0, 19.7, 20.8 and 25.1 for the five-year period from 1914 to 1918, inclusive. The year 1919 showed a slight excess of births over deaths and the year 1920 a still greater excess.

ACCIDENTS DUE TO EYE DEFECTS

The Committee on Elimination of Waste in Industry of the American Engineering Council has made public a report on accidents due to eye defects. The total number of industrial blind in the United States is given as 15,000 or 13.5 per cent. of the total blind population, this type of injury being the leading causative factor of blindness, according to the report, which was prepared by Earle B. Fowler. The eye is involved in 10.6 per cent. of all permanently disabling accidents.

The report stresses the importance of correcting subnormal vision among employees, saying that excess eye fatigue results in conditions which must produce a time labor loss from reduction in quantity and quality production. Substandard vision was found to be of great frequency. One investigation showed that out of 2,906 garment workers only 743 or a little over 25 per cent. had bilateral normal vision, 17 per cent. having normal vision in one eye, with the other defective. The highest percentage of defective vision was in the class of workers who made the greatest use of their eyes.

An examination of more than 10,000 employees in factories and commercial houses found 53 per cent. with uncorrected faulty vision. Of 675 employees in a typewriter company, 58 per cent. were found to be in need of correction by glasses. Of the rejections in the National Army, 21.7 per cent. were because of eye trouble. An examination of the vision of 3,000 employees in a paper box factory in Brooklyn, N. Y., showed that the percentage of normal was only 28. In every group of workers examined there were a large number who fell below the line and this number becomes appreciably greater if those who have subnormal vision are taken into account. The report continues:

> As in the correcting of other factors of occupational hygiene, standards have been set, so, after further study, visual acuity standards will have to be determined for each grade of workers and readjustments made, with alterations in our methods of testing acuity to suit conditions, until these standards give us the necessary minimum for each kind of work. As examinations are made at present, any set level would exclude workers shown by practical test to be very efficient producers.
>
> Many subnormal eyes will work well even for fairly trying work if conditions are good. Therefore, it is first of all urgent to bring the working conditions up to the best, on the basis now understood.
>
> Even the most superficial survey of lighting conditions reveals that in the majority of plants there is much improvement possible, in spite of the actual increase in production quantity and quality when poor illumination is corrected to standards now considered satisfactory. There seems to be no question of loss due to faulty conditions.

One estimate, the report stated, placed the loss due to faulty conditions in this country as above the entire cost of illumination. In 446 plants investigated only 8.7 per cent. were found to be in excellent condition, the other ratings being: Good, 32 per cent.; fair, 29.1 per cent.; poor, 18.8 per cent.; very poor, 3.5 per cent.; partly good, partly poor, 7.8 per cent.

THE YALE FOREST SCHOOL

Students from twenty-four universities and colleges, including four foreign countries, will attend the Yale Forest School at New Haven this year. Twenty-one men are candidates for the degree of Master of Forestry. The institutions represented in this attendance include the state universities at Cornell and Syracuse, N. Y., Maine, Minnesota, Montana, Washington, California, Pennsylvania, Missouri and Michigan. The foreign students come from the University of Christiania, Norway, Melbourne University, Australia, South African College, Capetown, South Africa, and University of Nanking, China. Yale continues to equip Chinese students to carry on the work started by former graduates—this year two will be in attendance. The students from Australia and South Africa are sent by their respective governments.

Owing to the growth of the school, new quarters were needed, and these will be secured through the recent gift of $300,000 from William H. Sage, B.A., Yale, '65, of Albany, N. Y., which will be devoted to the erection of a forest school building in memory of his deceased son, DeWitt Linn Sage, of the class of 1897.

During the fiscal year 1920–21, graduates of the Yale Forest School were chosen to fill 49 positions in forestry, including 10 in government work, 9 in state forestry departments, 11 as teachers in other schools of forestry, 11 as managers of forest estates or for corporations owning forest land, 5 with lumber companies, 2 in forest products and 1 in

city forestry. Among these positions was that of chief inspector of forests for New Zealand, consulting forest engineer for the government of India, chief of the timber section of the Income Tax Bureau, forester for the province of Shantung, China, state forester of Connecticut, commissioner of forestry for Maine, deputy commissioner of forestry for Pennsylvania, forester for Illinois, professor of forest engineering, Syracuse, special investigator, in tropics, for Western Electric Company, and many other positions in national, state and private forestry, lumbering, wood products and kindred lines.

Recognition of the versatility and training of graduates of Yale in forestry has caused a demand for their services which the school has been unable to supply, and an increasing field is opening up in commercial lines, in the handling of lumber sales, tropical products and by-products. At the same time the increasing interest in forestry by state and private land owners is giving rise to a demand for foresters in increasing numbers to fill these positions.

THE AMERICAN PUBLIC HEALTH ASSOCIATION

The fiftieth annual meeting of the American Public Health Association will be the occasion of a Health Fortnight. From November 8–19, New York City will be the scene of activities connected with this event, and the publicity with its slogan, "Health First," will stimulate interest throughout the country. Health Fortnight will include three major divisions—a Health Institute from November 8–11; a Health Exposition, November 14–19; the Fiftieth Annual Meeting of the American Public Health Association, November 14–19.

The Public Health Exposition will be conducted under the joint auspices of the Department of Health of the City of New York and the American Public Health Association. Already allotments of space indicate that at least two entire floors of the Grand Central Palace will be occupied by the exhibitors. The exhibits will include those of educational and philanthropic organizations and those of commercial houses producing approved articles of health value. The profits from the sale of tickets, after the cost of the Exposition and the Convention are defrayed, will be devoted to establishing nutritional clinics for the benefit of undernourished children.

The Health Institute from November 8–11 will present to visitors an opportunity to see the operations of established methods applied to various phases of public health work. About forty demonstrations have been planned.

Following the week of the Institute and the observance of Health Sunday, will come the opening of the scientific sessions, the meetings of the American Public Health Association in celebration of its semi-centennial. The sessions will begin on November 14 and the headquarters will be at the Hotel Astor. The scope of the meetings is indicated by their division into the following: General Sessions, Public Health Administration, Child Hygiene, Public Health Publicity and Education, Laboratory Section, Vital Statistics Section, Industrial Hygiene Section, and Food and Drug Section.

SCIENTIFIC NOTES AND NEWS

Dr. Livingston Farrand will be installed as president of Cornell University on October 20.

Owing to a severe illness from which he is slowly recovering, Dr. Ernest Fox Nichols is unable at present to take up the work of the presidency of the Massachusetts Institute of Technology.

Dr. Alexis Carrel has been elected a national associate of the French Academy of Medicine, of whom there are only twenty.

The College of Physicians of Philadelphia has awarded the Alvarenga prize to an experimental study of the "Selective Bacteriostatic Action of Gentian Violet," by Dr. John W. Churchman.

Dr. Marie M. Long has been appointed head of the department of child hygiene of the city health department, Memphis, Tennessee.

Professor G. W. O. Howe, of the City

and Guilds (Engineering) College, has been appointed superintendent of the electrical department of the British National Physical Laboratory.

Mr. J. Barr, head of the textile analysis department of the City of Bradford Conditioning House, has been appointed manager of the new yarn-testing bureau at University College, Nottingham.

Dr. William Walter Cort, associate professor of helminthology in the school of hygiene and public health of the Johns Hopkins University, has returned after spending four months studying hookworm larvæ in Trinidad, West Indies. He was director of the expedition sent out for that purpose by the International Health Board of the Rockefeller Foundation.

Mr. John Ritchie, associate editor of the *American Journal of Public Health* since 1918, has relinquished this position on the removal of the journal from Boston to New York.

Dr. Edward A. Spitzka has been appointed chief of the Medical Rating Section in the New York Office of the U. S. Veterans' Bureau, at 23 West 43d Street.

Dr. Thomas S. Roberts, professor of ornithology and associate curator of the zoological museum of the University of Minnesota, gave a lecture on Itasca Park, on September 23, in the lobby of the Mayo Clinic. The lecture was under the auspices of the Mayo Foundation Chapter of Sigma Xi and the Rochester Unit of the Minnesota General Alumni Association.

We learn from *Nature* that the death took place on September 11, at the age of seventy-one, of Mr. R. E. Baynes, senior student of Christ Church, Oxford, and Lee's reader in physics.

Mr. G. W. Walker, F.R.S., known for his work in physics and seismology, died on September 6 at the age of forty-seven years.

The annual conference of Potato Growers was held from October 4 to 6 at the University of California Farm School at Davis. The production and marketing of potatoes was presented in lectures, discussions and demonstrations at the University Farm Gardens. These lectures were given by members of the staff of the College of Agriculture of the University of California and the State and Federal Department of Agriculture. The meetings of the first two days were at Davis and the meetings of the third day at the University of California campus at Berkeley.

An institute of hydrology and climatology, containing laboratories, a museum, and a library, was inaugurated recently at the College of France. Lectures in hydrology will be given, and courses will be held to train specialists for watering-places and thermal and climatic stations.

It was recently reported in Science that Baron Edmond de Rothschild had contributed 10,000,000,000 francs for the endowment of an institute for scientific research. The foundation will be administered by a scientific council, composed of delegates from scientific institutions devoted to the study of physics and chemistry. It will include two representatives of the Academy of Sciences—one, each, from the sections of chemistry and physics. The Collège de France, the Museum d'Histoire Naturelle, l'Ecole Supérieure des Mines, the Faculté des Sciences de Paris, the Faculté de Pharmacie, l'Ecole Normale Supérieure, the Conservatoire National des Arts et Métiers and l'Ecole Polytechnique will each have one representative. There will also be several members elected by the council itself, so that the total number of members in the council will reach approximately twenty-five. The foundation will have at its disposal each year 600,000 francs to be distributed among investigators. In accordance with the terms of the endowment 300,000 francs must be distributed in small amounts; the balance may be bestowed in the form of one or more lump sums for costly researches of great importance. Educational establishments and government laboratories will not share in the grants offered by the foundation, as these will be reserved exclusively for the use of independent investigators in the field of physics and chemistry.

That Chile possesses certain agricultural products which may prove of great economic benefit to California is the belief of J. W. Gilmore, professor of agronomy at the university, and for the year 1921–22 exchange professor at the University of Santiago, Chile. Professor Gilmore has found a self-propagating bamboo tree which grows on dry lands, yet affords abundant forage for cattle during the summer months when other fodder is scarce. He also tells of two new beans that he has found, one of which is grown among the Indians of Chile, and the other a species which is suitable for higher elevations. He is collecting samples of all beans grown in Chile, and expects that some of them will prove to be better than those we already have. Another discovery which has been made by Professor Gilmore is a new white-seeded vetch, which he says should be a good cover crop for our orchards. Yet another is a new raisin grape grown in the dry lands of northern Chile which is exceptionally rich in sugar and which produces raisins of high quality.

The Journal of Terrestrial Magnetism reports that, according to information received from Dr. C. E. Adams, government astronomer and seismologist of New Zealand, a New Zealand Astronomical Society was recently established, and it is proposed as soon as possible to incorporate the society under an Act of Parliament. It is further hoped "that the Astronomical Society will be able to establish branches of the International Astronomical Union and the International Geodetic and Geophysical Union." The members include Dr. Adams, Dr. C. C. Farr, Professor E. Marsden, and practically all the astronomers and physicists of New Zealand.

The *Journal* of the Washington Academy of Sciences states that scales for the measurement of length are now being constructed directly from the fundamental wave lengths of light without the use of any intermediary standard such as the standard meter bars. For example, the Bureau of Standards has recently completed the rulings on a 6-inch standard scale for a manufacturing concern, using light waves from a neon tube as the length.

Nature states that after an interval of seven years the Geological Society of London has been able to resume the issue of its annual index to "Geological Literature Added to the Geological Society's Library," which is a complete work of reference, both as to subjects and as to the output of individual authors. The present part brings the matter down to the close of 1913.

Forecasts of the wheat yield in the northern hemisphere issued by the International Institute of Agriculture show that it will be approximately 50,200,000 tons, compared to 51,300,000 in 1920, according to a press dispatch from Rome. The crop in Europe, leaving out of consideration Great Britain, France and Germany, is estimated at 12,000,000 tons, compared to 10,500,000 last year. The United States and Canada are expected to produce 28,500,000 tons, against 28,600,000 tons in 1920, and India, Japan, Algeria, Morocco and Tunis will, it is said, yield 9,400,000 tons, against 12,000,000 harvested last year. The rye yield is computed at 8,200,000 tons, as against 6,700,000 tons in 1920, while barley shows an increase of 2.4 per cent. Oats, however, have suffered from the drought, and show a decrease of 12.3 per cent. The maize yield, based upon returns for the United States, shows a decrease of 6.2 per cent.

The New York City branch of the Alumni Association of the University of Wisconsin has established an annual scholarship of the value of $700 to be known as "The Zona Gale Scholarship"—named in honor of a distinguished graduate of the university—to be awarded to a student who has shown that he possesses special talent of an unusually high order, and who wishes to spend all his time in the university in pursuing courses which he thinks will develop his special talent, without being required to complete studies in which he has little or no interest. The holder of the scholarship will not be required to satisfy the regular entrance requirements if he is deficient therein.

This scholarship is open to any person in any part of the country who has given evidence

of exceptional creative ability in any field of human interest and activity. Nominations for the scholarship may be made to the registrar of the university by superintendents or principals of schools, by teachers, or by any one else.

UNIVERSITY AND EDUCATIONAL NEWS

Yale University has received gifts and pledges for the $2,000,000 additional endowment required to meet the terms of the conditional offer of $3,000,000 made at commencement in 1920 by "an anonymous friend of the university." No definite statement has been made of the manner in which the endowment will be used, but it is said that the Sterling bequest of $18,000,000 and the Harkness gift of about $6,000,000 had bestowed upon the university building facilities without provision for professorships, for which additional endowment is urgently needed.

Appraisal of the estate of the late William F. Armstrong, of New York, shows that he left property valued at $1,822,192. Public bequests exceeding $1,000,000, include a bequest of $100,000 and the residuary estate, amounting to $726,786, to Wesleyan University.

Dr. George W. Pierce has been appointed as Rumford professor of physics at Harvard University, to succeed Dr. Edwin H. Hall, who has retired from active teaching, and Dr. Theodore Lyman has been appointed Hollis professor of mathematics and natural philosophy, the chair successively held by the late Benjamin Peirce and Wallace C. Sabine.

Additions have been made to the senior staff in chemistry at the University of Illinois as follows: Drs. H. A. Neville, and C. D. Hurd, of Princeton; Dr. Edith H. Nason, of Yale; and Dr. T. E. Phipps, of California, in the division of inorganic chemistry; Dr. B. L. Souther, of Harvard, in the division of organic chemistry; Dr. G. F. Smith, of the University of Michigan, in the division of analytical chemistry; Dr. E. K. Carver, of Harvard, in the division of physical chemistry; Dr. M. J. Bradley, of Illinois, in the division of industrial chemistry, and Dr. R. E. Greenfield, of Illinois, in the division of sanitary chemistry and water analysis.

Julian D. Corrington has resigned the position of curator in the department of zoology of Cornell University, to accept the appointment of associate professor of biology in the University of South Carolina, Columbia, S. C.

DISCUSSION AND CORRESPONDENCE

GRAND AURORA OF SEPTEMBER 1–2, 1921 (AT SILVER LAKE, N. H., LAT. 43.9° N.)

An unusual aurora was seen at Silver Lake, N. H. (lat. 43.9° N.), on the night of September 1–2, 1921. Auroral glow was first noted at about 8 P.M. (75th mer. time). At 9 it was a bright arch with some streamers, and at 9:30 stretched from about NW. to NE., was double and locally knotty, and from time to time showed some motion when faint streamers reached up to a height of 30° above or down to the horizon under the general arch. Towards 10 the lights seemed to be getting fainter. At 2 A.M. I was awakened to see the sky filled with enormous flashing curtains. The whole family turned out onto the lake. No lights were needed and the pulsations were sufficient to be readily apparent in the house without looking at the sky. Viewed from the calm, "streaming" lake the sky was magnificent. Great folds of perhaps a dozen whitish curtains covered the sky except for a segment about 15° high in the south. Here and there a reddish tinge showed at the base of brighter folds. Waves of light rapidly traversed the sky upwards to the magnetic zenith, where some of the filmy curtains met in solid light traversed with beautiful curved lines. The stars, which were brilliant, attracted the attention of the small children nearly as much as did the sheets of light that "winkled." The youngest, 15 months old, gazed steadily for several minutes at the bright flickerings in the NW. at 2:30. The display slowly faded, but at 2:45 there were still some lights in the zenith and to about 30° south of it. The aurora, flashing all the time

continued bright at least in the NW. till 3:45 A.M., and probably later till the dawn blotted it out. Auroral pencils and sharp streamers being notably absent there was nothing to detract from the splendor of the great curtains.

On the following two nights there may have been auroras behind the clouds. On that of the 4th a moderate display with some pretty streamer action at about 3 A.M. was visible all night from Mt. Washington. The following two nights were cloudy. Then another display occurred. At 7:42 P.M. on the 7th a smooth auroral arch covered most of the sky up to the pole-star (45°) at Carter Notch, but by 7:57 there was but a low arch. The maximum with some streamers occurred apparently at about 10:30 P.M. The aurora was visible at other times throughout the night. On the evening of the 8th a faint arch broken by streamers in the NNW. was visible; and on the following evening there seemed to be a faint arch.

Charles F. Brooks

Silver Lake, N. H.

THE COCCIDÆ OF CEYLON

Entomologists are indebted to Mr. E. E. Green for by far the most ambitiously conceived and most admirably executed contribution to the knowledge of the Coccidæ or scale insects that has ever been made—the "Coccidæ of Ceylon." This work, which is still incomplete, has been issued in parts and the final part would have appeared long ago but for the interference of the war. I am informed by Mr. Green that as matters now stand the long-hoped-for appearance of this final volume seems indefinitely postponed because of the enormously increased costs of printing. The only hope that he may be able to proceed with its publication at all lies in the possibility of obtaining adequate assurance that the entire issue can be sold.

It may at first appear that a work which deals with but a limited aspect of the fauna of a comparatively remote island such as Ceylon can have but little interest for Americans. Yet such is decidedly not the case with this work. Many of the species included are practically cosmopolitan and the ever present possibility of the spread of others through the agencies of commerce makes desirable any information that can be obtained concerning them. The Coccidæ of Ceylon is indispensable to any one who is at all seriously interested in the scale insects. Its completion is a matter in which all students of the Coccidæ should take a personal interest.

The price of the final part has been set at 3 pounds, which is the actual cost of publication, and of the entire series of five parts at 8 pounds. To those who are familiar with the work the price will not seem in the slightest degree excessive. Mr. Green says:

> If I could get definite promises of support from a considerable number of prospective purchasers, I should feel justified in going ahead at once.

It is sincerely to be hoped that these promises may be forthcoming. Correspondence should be addressed to Mr. E. E. Green, Way's End, Camberley, Surrey, England.

G. F. Ferris

Stanford University, Calif.

A METHOD OF PROTECTING MICROSCOPIC SECTIONS FROM MECHANICAL INJURY

Those who have to deal with classes using chiefly microscopic slides, especially of embryos, will appreciate the fact that most of the damage to sections comes not from breaking of the slide but as the result of pressure on the cover glass. Such damage would not be possible but for the fact that most of the balsam remains fluid, even after many years, and consequently offers no firm support to delicate structures. If only some firm transparent substance could be found in which the sections might be imbedded the defect resulting from the fluid nature of the balsam might be counteracted and the tissues kept in perfect condition for successive classes.

Celloidin sections fulfill most if not all of the mechanical requirements, but are unsuitable because of the great amount of time required for cutting and mounting serially. However, these considerations led to the development of the following process which combines all of the advantages of the paraffine

method with some of those of the celloidin technique.

From ordinary series of paraffine sections the parffine is removed in xylol, the slides being transferred with great care to 100 per cent. alcohol and then to 1 per cent. parlodion from which they are removed slowly one by one and placed in 80 per cent. alcohol, an old method for securing sections to the slide especially for preventing embryonic membranes from floating about. After staining by any method and dehydrating, the slides are removed singly from 100 per cent. alcohol, placed in a horizontal position, and the sections *quickly* and *evenly* flooded with 2 per cent. parlodion. About 10 to 14 drops, from an ordinary 2 c.c. pipette, placed in two rows and allowed to stand one to two minutes uncovered were found to form a film of very uniform thickness and of sufficient firmness to be hardened without wrinkling when slipped into 80 to 90 per cent. alcohol. The proper degree of drying is indicated by a minute rippling of the surface of the celloidin. The slide is again dehydrated, care being taken not to use alcohol strong enough to dissolve the celloidin; and then cleared in a mixture of 40 per cent. beechwood creosote in xylol, followed by plain xylol. Creosote alone clears quite as well but does not flow as readily as the mixture which, moreover, clears from 95 per cent. alcohol. Such slides may be thoroughly drained in the air for several minutes before covering in the ordinary way with balsam and a cover glass.

It should be noted that the parlodion must be applied *evenly* so that the balsam will dry without the formation of large air bubbles. The latter can be entirely avoided. Furthermore, thinner films suitable for use with oil immersion objectives can be obtained by using a solution of parlodion somewhat more dilute and less in quantity.

By this method sections of the most delicate structures are imbedded in and under a perfectly transparent, unstained layer of celloidin so tough and resistant that sufficient pressure may be applied to the cover-glass to crush it without the least injury to the tissue. Slides so treated can not be distinguished from ordinary slides.

J. A. Long

Zoological Laboratory,
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QUOTATIONS

THE BRITISH ASSOCIATION

The Edinburgh meeting of the British Association for the Advancement of Science came to a successful end yesterday. It was the largest in numbers for many years; and although the deficit on the accounts of last year made it impossible to devote money from current funds to research, there is a better prospect for the immediate future. Thirteen sections sat concurrently during the greater part of the week. It can not be pretended that all the proceedings conformed with the normal definition of science. Humor in school children, episcopal opinions on citizenship, the relative merits of Latin and Esperanto, and the history of Old Edinburgh are worthy occupations of the human mind, but lie somewhat uneasily with sterner subjects. The general committee showed a marked reluctance even to consider the advantages of a stricter definition of the scope of the association, and the adherents of sections more loosely attached to experimental science very naturally opposed proposals which they feared might lead to their extinction. On the other hand, the policy of the Council in arranging intersectional discussions on topics of wide interest was warmly approved in theory. In practise it led to some of the largest audiences in the history of the association. It was possible to give in our columns only slight indications of the general purport of the discussions on the structure of molecules, the age of the earth, and instinctive behavior; but our special correspondent laid stress on the wide interest taken by the members of the association in these deeper problems.

Sir Edward Thorpe, the president, was unfortunately prevented by illness from all but a formal attendance on the last two days of the meeting. But his opening address, read for him by the principal of the university,

dealt with the central point of contemporary scientific interest. Critical phases occur in the evolution of knowledge of such a kind that they seem to be revolutions in thought. The new vision of the atom as an ordered system, a macrocosm of energy in microcosmic space, is one of the greatest of these stages in the history of man's conquest of Nature. Doubtless, as the president explained, the discovery was reached along many converging paths of theory and of experiment. It was even predicted, fifty years ago in a presidential address, also at an Edinburgh meeting of the association, when Kelvin summed up the program of the past and suggested the lines along which future research must move. Sir James Dewar, at a dinner given by the Royal Society of Edinburgh last Tuesday, recalled even earlier predictions. But its attainment has led to results almost overwhelming in their importance. It has reconciled physics and chemistry in a higher unity. It has given a clock by which the age of the earth may be told. It has allowed astronomers to explain the pulsations of the distant stars. It has opened up prospects of a new and inexhaustible source of power for the practical uses of mankind. The Edinburgh meeting of the British Association will long be remembered as that at which the new atomic age was made known to those outside the inner ring of science.—The London *Times*.

SCIENTIFIC BOOKS

KEEN'S SURGERY

The first six volumes of Keen's "Surgery" recorded the progress of surgery down to 1913. In the preface to the additional volumes Dr. Keen states that the general purpose is to make available the lessons of the war for the surgery of peace and to set down every worth while surgical achievement since the war; and both of these objects have been accomplished in a masterful way. The two volumes consist of a series of monographs written by authors of international reputation and comprise 1800 pages with 996 illustrations, 29 of them in color.

The editor counts it "a crowning privilege of his long life to be associated with such a distinguished company of authors." The distinguished authors also doubtless count it as an inspiring privilege to have been associated in the production of the work with such an enthusiastic student and able teacher.

In the two new volumes the names of many former contributors are absent and new names are added. There has also been some shifting of subject matter. The editor has added many footnotes of great help to the reader, and has made many cross references to statements of the different authors of the various chapters. Typographical errors are few and there is evidence of careful editing and proofreading.

Much space in the two volumes is devoted to the organization of the medical departments of the Army and Navy. The chapters by Colonel Ashford of the U. S. Army, by Captain Bell of the U. S. Navy and by Lieut. Commander Stephens of the British Navy occupy 183 pages, including many photographs, drawings, diagrams and lists of furniture and equipments. Much information is given of value in civil practise, such as the treatment of shock, burns and suffocation by fumes and smoke.

The chapter on Gas Gangrene by Sir Cuthbert Wallace is complete and most beautifully illustrated. Some qualification seems necessary for the statement it contains that "suture of the main artery is recommended as a prophylactic measure against massive gangrene."

The chapter by Cannon on Traumatic Shock, although occupying only 19 pages, is exceedingly valuable, being not only authoritative and scientific, but practical as well.

Sir William Thorburn in his contribution on Injuries of the Spine and Spinal Cord emphasizes the treatment of the patient as a primary principle. The importance of the management of the bladder for example is stressed by the remark that "the bladder holds the key to life or death for the patient." In his chapter on Injuries to the Peripheral Nerves the author fails to mention the work

on the suture of nerves by certain Americans, especially Hober, Dean Lewis and Frazier.

Military Surgery of the Vascular System by Matas is a scholarly contribution. It is a pity that much of it is in fine print. In the treatment of gunshot wounds of the large vessels Matas defends the opinion so long held by him that when possible large blood vessels should be sutured and not ligated.

Surgery of the Head, previously contributed by Cushing, has been written for Volume VIII. by Neuhoff. It is a splendid résumé of the subject but no mention is made of Frazier's method of osteoplastic repair of cranial defects.

The Relation of the Dental Surgeon to the Treatment of Fractures of the Jaw is described by Darcissae of Paris.

Chevalier Jackson's contribution upon Laryngoscopy, Bronchoscopy and Esophagoscopy is a monument to the technical achievements and teaching ability of this great man.

Surgery of the Thorax by Heuer of Baltimore is a scolarly contribution occupying 80 pages and referring to 118 literary contributions. The enormous progress made in the surgery of the thorax during the war could scarcely be recorded in less space than this. The compliment paid to one of the younger surgeons of America by including him among the list of authors is amply justified by his contribution to the system.

Crile's chapter on Surgery of the Abdomen and Pelvis is a concise one-man contribution.

There is a short chapter by Mayo and Balfour on Surgery of the Gall Bladder and the Biliary Ducts, which deals principally with injuries and repair of the hepatic ducts.

Deaver and Pfeiffer have taken the place of the lamented Murphy in discussing appendicitis. The chapter is a short statement of Deaver's personal opinions based upon the experience that this surgeon has had with the disease. It is a great comfort to learn on page 443 that he is finally converted to the belief that morphine may be useful "to induce sleep if necessary, as well as to allay anxiety." The case report on page 441 also indicates that he has seen some cases of appendictis with peritonitis in which it is wise to delay operation. His remarks on the abuse of purgatives on page 449 should be widely read by general practitioners.

The chapter on the Bladder and Ureters by Bransford Lewis is well illustrated by pictures of the many instruments devised by the author and the text of the subject is brought up to date.

Surgery of the Prostate by Hugh Young occupies 76 pages and includes a description of the operation recently devised for the cure of recto-urethral fistula.

Physiotherapy in Surgical Treatment has made enormous advances as a result of the war and has come to be thoroughly appreciated. This chapter by McKenzie is an admirable presentation of the subject in its practical value to surgeons in civil life.

Four chapters are devoted to the diagnostic and therapeutic usefulness of various biologic sera and vaccines and chemico-therapy in surgical diseases; the status of radium in surgery; the diagnostic and therapeutic uses of the X-ray; and electro-desiccation and electro-coagulation methods in surgery. It is a question if it would not be more satisfactory to include the essentials of this knowledge in their proper place in studying diseases for which they are employed rather than in separate chapters.

The Surgery of the Infectious Diseases by George E. Armstrong, is a very practical chapter. The work by Keen many years ago in calling attention to the great frequency of surgical complications during typhoid fever has been of inestimable service in saving lives through the recognition and cure of surgical complications of the disease. The recent epidemic of influenza and the experiences in the camps with epidemics of measles, mumps and pneumonia have shown the great importance of being constantly on the lookout for surgical complications of affections hitherto regarded as purely medical.

The chapters dealing with ether and nitrous oxide anæsthesia have been rewritten. Harris's supplemental chapter on local anæsthesia

is full and authoritative. Hugh Cabot still regards spinal anæsthesia as having a place in surgery.

The chapter on Poison Gas in warfare is not solely of historic interest, because surgeons on ambulances and those connected with industrial plants and chemical laboratories will find much of practical importance.

The final chapter on a most successful method of dressing an artificial anus prepared by the editor himself is in the form of a case report and is the type of literature which is of the greatest practical use to surgeons and patients.

The index of the system consists of four "keys"; first, each volume as it stands upon the shelf carries a conspicuous label of the general subject matter it contains; second, as we open the book the table of contents is quite complete; third, each volume has a separate index; and finally, the complete index of the entire eight volumes occupies 182 pages in the form of a desk volume and makes it perfectly easy for one to find any reference he may desire.

STUART MCGUIRE

SPECIAL ARTICLES

A NEW GRAPHIC ANALYTIC METHOD

1. THE graphic methods which deal with a treatment of two or three variables are commonly based on a relation of the variables to a system of rectangular cartesian coordinates. If the equation is known the laws may be expressed in the customary way by the methods of analytic geometry.

If, however, we are confronted with a system of two or more equations which are so related to each other that the growth of one will influence the growth of another (in a negative and positive sense) the following method will furnish a means of expressing such movements in a concise form and in a manner well adapted for the purpose of analysis.

Suppose we have three general equations:

$$x = f\ (a), \quad y = f\ (b), \quad z = f\ (c),$$

where the change of a will affect x as well as y and the change of b will affect y as well as z and if further $f\ (a)$, $f\ (b)$ and $f\ (c)$ are quotients expressed:

$$\frac{a}{b}, \quad \frac{a}{c} \quad \text{and} \quad \frac{b}{c};$$

we have then:

$$x = \frac{a}{b}; \quad y = \frac{a}{c}; \quad z = \frac{b}{c}$$

and notice that each quotient or independent variable is related to the other independent variable by the possession of one of its algebraic members.

If a number of equations which have a relationship of this nature is brought into a system of positive coordinates as shown in Fig. 1, the four quadrants and the coordinates

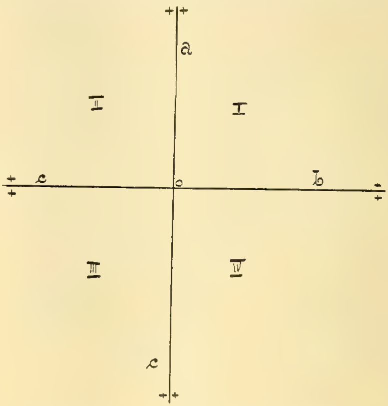

FIG. 1.

forming them may be named in the following manner:

I. Quadrant $a\ b$
II. Quadrant $a\ c$
III. Quadrant $c\ c$
IV. Quadrant $c\ b$

Therefore the ordinates of each quadrant will have two different coordinates or scale values with the exception of the third or neutral quadrant which axes have the same scale values c and are acting in a translative sense rotating the value c 90° to bring it in the third and last relationship with value b, in the fourth quadrant.

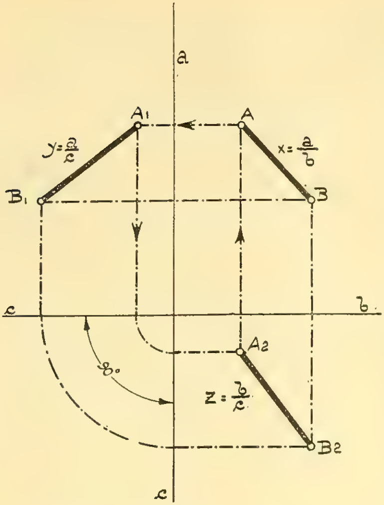

Fig. 2.

2. In such a system the growth (negative and positive) of a variable may be observed by connecting the plotted points of each quadrant which satisfy their respective equation with the points of each equation in the other quadrants, thereby obtaining for each set of three points a cycle line A, A_1, A_2 (as shown in Fig. No. 2). These points not only represent the actual values of x, y, z, but their location in reference to their respective axes represents the quotients expressed by the equations.

For example, Point A would represent by its location the quotient of certain values of a and b; or A_1 would represent by its location the quotient of certain values of a and c, and so on.

The application of the method may be illustrated by an actual example. Suppose we have the statistical data shown in the table given below. These data may be advantageously analyzed as outlined (Fig. 3).

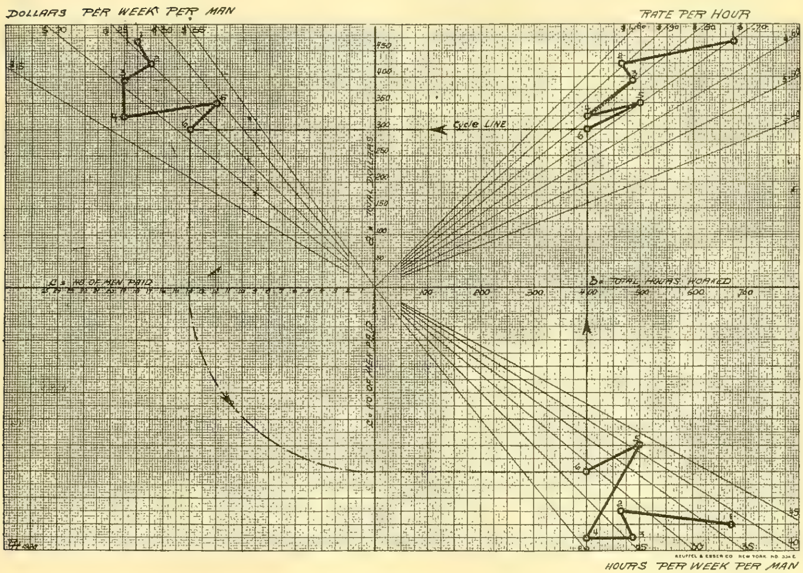

Fig. 3.

The a scale representing the number of dollars paid.

The b scale representing the number of hours worked.

The c scale representing the number of men working.

	$a=$ No. Dollars Paid	$b=$ No. Hours Worked	$c=$ No. Men Working
1st week	469	675	18
2d week	425	464	17
3d week	393	485	19
4th week	325	400	19
5th week	350	500	12
6th week	300	400	14

The quotient a/b will represent the hourly rate paid. The quotient a/c will represent the amount paid per man. The quotient b/c will represent the hours worked per man.

The radiant lines starting from the point of origin of the coordinate system are the equations of lines which represent a constant quotient. The location of the points given by the actual values of the table with reference to the radiant lines of each quadrant therefore determines graphically the actual value of each quotient.

For example, in the sixth week we observe the location of point 6 in the *first quadrant* between a rate of \$.70 and \$.80 per hour (actual value $300/400 = \$.75$).

In the *second* quadrant (as connected by the cycle line) the location of point 6 is between \$20 and \$25 a week (actual value $300/14 = \$21.42$) and nearer to the \$20 line.

In the *fourth* quadrant (as connected by the cycle line) the location of point 6 is near the 30 hours per week line (actual value $400/14 = \$28.57$ hours).

If a longer period and a greater number of values are under observation, a moving average could be calculated and plotted in a similar way. There are a great number of data which have a similar relation to each other and may be presented and analyzed by this method.

Furthermore empirical data obtained by experiment may be subjected to this method and a possible positive or negative correlation of their respective movements determined.

R. von Huhn

New York City

THE AMERICAN PHILOSOPHICAL SOCIETY[1]

The etiology, prophylaxis, and serum treatment of yellow fever: Hideyo Noguchi. *Leptospira icteroides* was first isolated in 1918 from cases of yellow fever in Guayaquil; later the organism was obtained from yellow fever cases in Merida, Yucatan (1919) and in northern Peru (1920). The finding has also been confirmed in Mexico by Dr. Perez-Grovas, who transmitted yellow fever from cases of yellow fever in Vera Cruz in 1920 and obtained cultures. The most recent confirmation has come from Dr. Le Blanc of the Rockefeller Institute staff, working in Vera Cruz. The killed cultures of *Leptospira icteroides* were first used for protective inoculation against yellow fever in Guayaquil in 1918, where 427 vaccinations were carried out. The results were so encouraging (the morbidity rate among vaccinated and unvaccinated during the same period being 11 and 110 per thousand, respectively) that a vaccine several hundred times stronger has been made in large quantities and employed in Mexico and various Central and South American countries, the total number of non-immune persons reported vaccinated being about eight thousand. The development of protection is slow, requiring about 10 days for completion, and persons exposed to yellow fever just before vaccination or immediately afterwards are not protected by vaccination. Excluding such instances, however, there has been no case of yellow fever among the eight thousand vaccinated in the various localities, while among unvaccinated persons during the same period and in the same areas there have been about seven hundred cases of the disease. The use of vaccine furnishes a rapid method of elimination of non-immune persons from areas where yellow fever is epidemic. By the application of sanitary measures to eliminate the mosquito carrier and vaccination in the meantime to cut off the supply of non-immune material from the infected mosquito, a threatening epidemic of yellow fever in Guatemala and Salvador in 1920 is reported to have been checked within one month from the appearance of the first cases, that is, before a second set of cases had developed. The value of vaccination as an emergency measure does not, however, minimize the importance of the anti-mosquito operations, the elimination of both factors—the non-immune human being and the infected mosquito—being essential

[1] Abstracts of papers presented at the annual meeting, Philadelphia, April, 1921.

to the eradication of yellow fever. A therapeutic serum is also available for treatment of yellow fever. It has already been employed in 152 cases, and persons treated before the third day of illness have almost invariably recovered, the exceptions being those cases in which the quantity of serum used was too small to have any effect. By the fourth day of illness the injuries to organs are so great as to be irreparable in severe cases of yellow fever. The usual mortality in yellow fever, 50 to 60 per cent., has been reduced to 9 per cent. by the use of the serum. The records of vaccination and serum treatment presented here comprise the work of a number of observers. The initial vaccination experiments in Ecuador were carried out with the cooperation of Dr. Pareja and the Direccion de Salubridad of Guayaquil; the statistics from Central America cover the work of Lyster, Bailey, and Vaughn; for the records of Mexican cases I am indebted to the Consejo Superior de Salubridad (Drs. Vasconcelos and Casasus), to the Junta de la Sanidad de Yucatan (Dr. Hernandez), and to Dr. Le Blanc; the work in Peru was done with the cooperation and assistance of Dr. Kligler and the Peruvian health authorities.

Hereditary influences bearing on the resistance to tuberculosis: PAUL A. LEWIS. Certain inbred strains of guinea pigs, which have been maintained for a number of years at the Bureau of Animal Industry, Washington, D. C., have been tested by us as to their resistance to tuberculosis. It is found that these strains differ appreciably in the length of life after a standard inoculation. The differences between the strains are more considerable than differences due to other factors, such as sex, age, weight, etc. That the differences observed among the strains have a hereditary basis is also emphasized by the influence on resistance observed in crosses among these strains.

Signs of sanity: STEWART PATON. Probably the most important question in the world to-day is whether man is capable of directing intelligently the civilization he has created and organized. International as well as industrial peace can only be attained in proportion as we are capable of understanding and controlling human nature. Following the outburst of insanity in 1914, which plunged the world into war, no attempt has been made by statesmen or diplomatists at the peace conference to discriminate between the signs of sanity and insanity. In order to understand the nature of sanity one must use two methods of investigation: (1) analytical, (2) synthetical. Man has paid a heavy price for neglecting the latter. He has studied parts of the human machine, but has made little effort to notice the behavior of the entire machine. Judging sanity and insanity is a biological and not a psychological problem; it is not a question of body and mind, but of body-mind. The organization of the body-mind in sanity: (1) provides channels for discharge of energy in action; (2) assists individual to face squarely problems of actual life and (3) rewards effort by definite sense of achievement and feeling of adequacy. Bolshevism, radicalism and the tendency to think in terms of class distinction are defense reactions of inadequates afraid of facing their own personal problems. Success of individual, future of democracy and the fate of our civilization depend upon the recognition of these biological principles and the cultivation of mental processes favorable for sane thinking and acting.

Grass rusts of the Andes (based on collections by Mr. and Mrs. Holway): J. C. ARTHUR. The grass rusts form a peculiar group of minute parasites of great interest to the botanist on account of their curious and varied forms and of equal interest to the agriculturist and economist on account of the injury they do to crops, especially cereals. The Andean region embraces a strip rarely more than a hundred miles in width of elevated plateaus and high mountains extending along the whole western border of South America through Colombia, Ecuador, Peru, Bolivia and Chile. The cereal crops and forage grasses are of economic importance throughout the region, but a study of the rusts affecting them had made little progress until the exploration undertaken by the Holways. Barely a score of forms had previously been reported, but the number is now more than double, and includes some that are new to science. Much critical knowledge has also been secured.

The action of bases and salts on biocolloids and cell-masses: D. T. MACDOUGAL. The strong metallic bases, potassium, sodium and calcium are found to exert a limiting effect in concentrations of $0.01M$ on agar, when applied as hydroxides or chlorides, but this action is reversed when solutions diluted to $0.001M$ or $0.0001M$ are used, in which concentration they may occur in living matter. A similar accelerating action for hydrochloric acid at 0.0001 normal was found. Biocolloids of agar and gelatine showed specialized and accelerated hydration in similar solutions. No connection could be established between the hydrogen ion concentration and swelling as agar shows exaggerated swelling at P_H values

from 4.2 to 11. Effects as of balanced solutions were obtained with agar, and suggestions of similar action with agar-gelatine-salt mixtures. The incorporation of nutrient salts in agar and biocolloids in minute proportions such as might occur in plants increased the swelling capacity of some mixtures, in contradiction to earlier announcements by the author. Roots of various plants showed special effects in swelling, and also variations according to the ecological type of these organs. Such differences are determined by the composition of the cell-colloids. Finally the facts confirm an earlier statement to the effect that all substances known to facilitate growth of plants accelerate hydration of growing tissues, and of biocolloids simulating their protoplasm when used in low concentrations equivalent to those in which they are usually encountered by living matter.

Growth of trees: D. T. MacDougal. Extended measurements of the growth of many trees of a number of species have been made by the use of the newly designed dendrograph, which makes a continuous record of changes in diameter, and the recently perfected dendrometer, which registers total change in circumference. It is found that the period during which growth takes place even in equable climates with indeterminate seasons does not extend over more than two or three months, and that growth is not rhythmical in any sense, but depends upon food-supply, temperature, moisture and other environmental conditions. Awakening of buds, formation of leaves and flowers, and elongation of branches may occur many days or even weeks before trunks begin to enlarge. The leaves of a beech tree in Baltimore began to unfold April 10, 1919, and enlargement of the trunk began about May 18. Daily equalizing variations by which a tree may be actually smaller in mid-afternoon than at sunrise are greatest in the ash, pine, spruce, fir and walnut, and least in poplars, sycamore, beech and oak trees. Accurate measurements of the changes in trunks internal to the growing layer show that these variations are directly connected with the mechanism of the ascent of sap and are explainable upon the assumption of a rigid water column in a trunk composed of wood-cells and vessels capable of some shrinkage and expansion. Crudely expressed the trunk behaves like a heavy hose feeding from a pressure system to a fire engine. When the engine tends to take water faster than supplied, the hose tends to collapse; when the engine slackens its action, the hose swells.

Fishes of Ecuador and Peru: Carl H. Eigenmann. The fishes of the Guayas basin on the Pacific slope of Ecuador and those of the rivers of Chile are completely different in species. Even the genera with the exception of the mountain catfish *Pygidium* are all different. Excluding the marine fishes even the families and orders of fishes in the two areas are largely different. The differences between the two faunas are so great there is not a shadow of a doubt that in the main their origins were different. The Chilenian fishes came from the south. The Guayas fishes came from the Amazon. The Pacific slope of South America between Panama and Patagonia varies in width from a few yards in Colombia, west of the Atrato river, to a hundred miles or more. The slope is extremely wet in Panama and Colombia, varies from wet in the north of Ecuador to dry in the south of Ecuador. The slope varies from *dry* in northern Peru to *very dry* in southern Peru, and *almost* if not *absolutely dry* in Chile, south of Copiapo. The Guayas basin drains the area between a coast range and the Cordilleras of central Ecuador. The Guayas has the distinction of being the only river with a flow in the main parallel to the Andes. All the other Pacific slope rivers between the equator and Cape Horn (with the exception of the Rio Santa) flow direct from the Andes westward to the Pacific. The Guayas basin is the largest river basin draining into the Pacific between the equator and southern Chile. The rivers grow smaller south of Ecuador to northern Chile. A stretch of over 500 miles in northern Chile is crossed by but one river, the Loa. The first river south of the great desert of Atacama is the Rio Copiapo. I fished from Copiapo southward through central Chile over a stretch nearly a thousand miles long. The general conclusion reached is that the fauna of Chile is at its height between Concepcion and Valdivia. Going north from Valdivia one genus after another disappears. *Aplochiton,* a trout-like genus of Australia and Chile and *Galaxias,* another genus of Australia and Chile, reach their farthest north in the Bio Bio. The peculiar catfishes *Dyplomyste* and *Nematogenys* reach their farthest north in the Maipo. *Percichthys* reaches the Aconcagua. North of the Aconcagua in the region of the extinct or dying rivers but three species of the Bio Bio fauna remain: a "*peje rey,*" *Basilichthys,* the ubiquitous catfish *Pygidium* and *Cheirodon.* The little *Cheirodon* whose ancestors have come from tropical Brazil I caught as far north as Vallenar. In the Copiapo I caught no native fishes. The *peje rey* extends all the way to Lima, Peru.

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MAGNETIC SUSCEPTIBILITIES[1]

A. Classification of Bodies, Magnetically.—1. Let us assume that we have at our disposal a *uniform* magnetic field whose intensity, H, and direction we can vary at will. H will be expressed in Gauss and may be graphically represented by drawing through a unit area a number of parallel lines numerically equal to H. Into such a field of force we may introduce any substance we wish and study the effects which that substance may produce on the number of lines of force which thread through the space we call the magnetic field. Experimentally we find that any substance when brought into a uniform magnetic field causes a perturbation of the lines of force, the character of which separates all substances into two classes, viz., dia- and paramagnetic bodies. The lines of induction are a continuation of those of the field, but in the case of a paramagnetic substance are more closely packed together, while in a diamagnetic body they are further apart. Ferromagnetic substances are special cases of paramagnetism of which the lines of induction are, relatively, very closely packed together. A comparison with the electric currents would make this idea more precise.

Suppose a sphere of metal introduced into a mass of mercury traversed by a uniform current: the lines of flow which were originally parallel would tend to pass in greater number through the sphere if it were a better conductor than the mercury, and, on the contrary, in smaller number if it were a worse conductor. The words conductivity for lines of flow and permeability for lines of magnetic induction thus correspond to analogous ideas.

If we let B represent the number of lines of induction threading through unit area in

[1] Read before a joint meeting of the American Physical Society and Section B of the American Association for the Advancement of Science, December, 1920.

the substance, placed in a magnetic field of strength, H, then we have the relation existing between these quantities given by the equation

$$B = H \pm 4\pi I. \qquad (1)$$

The number of lines of force which thread out from a magnetic pole is $4\pi m$. In equation (1) B is less or greater than H as I is negative or positive. That is to say, there is developed at opposite ends of the specimen placed in the magnetic field, H, a polarity which in case of paramagnetic substances is additive to H and makes B greater than H while in diamagnetic substances an opposite polarity is developed whose field subtracts from H and makes the resultant lines of induction further apart than the lines in the field of force. I, therefore, may be defined as the pole strength per unit area of the pole developed in the specimen, or it is the intensity of magnetization of the material examined. More frequently I is defined as the magnetic moment per unit volume, for if we take a cylinder of any material and place it in a magnetic field, then $AIl = M$, the magnetic moment of the cylinder, where A is the crossection and l is the length of the cylinder. $I = M/Al = M/V$, or the magnetic moment per unit volume. It is assumed that the poles are at the ends of the cylinder. Next divide equation (1) by H and we get

$$\mu = 1 \pm 4\pi k, \qquad (2)$$

where μ is called the permeability, and k the susceptibility. $\mu = B/H$ is a measure of the power the substance has for increasing the external field. This is a quantity in which the electrical engineer is particularly interested. Further, $k = I/H$ seems also to be a factor due to properties inherently bound up with the substance introduced into the magnetic field. This factor k is called the magnetic susceptibility per unit volume. In order to get the susceptibility per unit mass we must divide the volume susceptibility by the density of the substance. As k is negative or positive so is a substance dia- or paramagnetic. It is a property in which physicists must be vitally concerned in building up a magnetic theory and developing comprehensively the architectural design of the atom. Before we have finished this discussion we must ask the question, where does the property of susceptibility lie—in the electron, atom, molecule or aggregation of molecules?

2. Next let us work with a non-uniform magnetic field such as one has between the conical pole-pieces of an electromagnet and let us give definite shape to the samples of the various materials investigated, viz., ellipsoidal form. This time we will observe the behavior of the specimens as the magnetic field is applied to them. Experimentally, we discover that here again all substances divide themselves into two groups; one class turns in the magnetic field so as to set the greatest length normal to the lines of force of the magnetic field and the other class with major dimensions parallel to the field. Not only that but those substances which set themselves normal to the field are just those which we call diamagnetic in our first experiment and those which turn with greatest length parallel are the paramagnetic elements, which also include the ferromagnetic substances. Thus we have another way in which to distinguish dia- from paramagnetic substances. It is to be noted that in a uniform magnetic field all elongated bodies set themselves parallel to a magnetic field. The reason for the orientation cited above for diamagnetism is because the poles of the substance tend to move from stronger to weaker fields.[1a]

3. As a third experiment let us work with a non-uniform magnetic field in which the variation of the field along any direction is known. Introducing our samples in the form of spheres into this field we note that they all tend to move in one direction or the other in the field, either from a point of large field intensity to one of lower or vice versa. As in our previous observations there are two classes and we find that diamagnetic substances always move from higher to lower field intensities and paramagnetic are urged in the opposite direction. Ferromagnetic bodies

[1a] Poynting and Thomson, *Elec. and Mag.*, p. 258, 1914.

distinguish themselves by their energetic paramagnetic action in the magnetic field.

The foregoing may be summed up by the following:

TABLE I.

Diamagnetic substances, μ less than unity, k negative and does not vary with H.

Paramagnetic substances, μ small but greater than unity, k positive and does not vary with H.

Ferromagnetic substance, μ greater than unity and varies with H, k positive and a complicated function of H and T.

This is practically the state of knowledge in which Faraday, Plücker, Becquerel and others left this field of knowledge fifty years ago.

B. Modern Theories of Dia-, Para- and Ferromagnetism.—The electron theory forms the basis of the modern theories of magnetism which took their rise from an extensive investigation made on the magnetic properties of bodies by Professor Curie,[2] whose name is mainly associated with the discovery of radium. Yet in this field, which we are discussing, Curie's name must always stand forth as one of the pioneers.

Based largely on Curie's work Langevin[3] has built up a theory of dia- and paramagnetism which has been extended to ferromagnetism by Weiss.[4] These theories have been of value in that they have led to new experimental evidences concerning the behavior of substances magnetically, so that in our discussion these three names, naturally, will receive more attention than others, although the contributions of others are exceedingly important. Among others to be mentioned are Honda, K. Onnes, Dewar and Fleming, Oosterhuis, Pascal, Oxley, Kunz and Owen.

In a long and careful series of investigations, Curie observed the behavior of various substances when placed in a non-uniform magnetic field, in which the observations were extended over a wide range of field intensities and temperatures. Figures illustrating the apparatus used will be found in the original articles. The range of field strengths was from about 25 to 1,500 c.g.s. units and of the temperature from about 22° C. to 1350° C. His results are generally expressed in terms of mass susceptibility where k is positive when the substance moves toward more intense field strengths and negative when oppositely drawn. Curie examined a series of substances in each of the three groups, dia-, para- and ferromagnetic materials.

1. *Diamagnetic Substances.*—Rock salt, quartz, water, KCl, K_2SO_4, KNO_3, S, Se, I, Br, Te, P, Bi, and Sb were the substances studied. Special attention was paid to water in order to determine k absolutely as a standard of reference. Bismuth showed remarkable properties as it passed through its melting point. In every case k was independent of H and with the exception of three all gave a value of k independent of temperature and of physical state.

2. *Paramagnetic Substances.*—Air, palladium, $FeSO_4$ in aqueous solution, oxygen, glass and porcelain were the subjects investigated. Glass and porcelain were studied because they were used as the material for the container in which to test gaseous and other forms of materials. The other four paramagnetic substances were found to have a susceptibility independent of field strength and satisfied the condition that k varies as $1/T$. Beside the work on $FeSO_4$ in water Curie tried also the magnetic salts of Co, Mn and $NiSO_4$. The first two fitted in with the general law but $NiSO_4$ showed too rapid a change in its susceptibility for the inverse temperature law. The second law of Curie that k varies as $1/T$ may be expressed by saying that $kT = \text{a const.}$ which has become known as Curie's constant.

3. *Ferromagnetic Substances.*—Curie investigated nickel, soft iron, magnetite and cast iron. He paid particular attention to soft iron, studying the variation of I with T when H was maintained constant and again the variation of I with H when T was kept constant. For a certain range of temperature above the critical temperature of magnetic

[2] Curie, *Ann. de Chim. et de Phys.*, 5, 289, 1895.

[3] Langevin, *Ann. de Chem. et de Phys.*, 4, 70, 1905; *Jour. de Phys.*, 4, 678, 1905.

[4] Weiss, *Jour. de Phys.*, 6, 661, 1907; *Comp. Rend.*, 152; 79, 187, 367, 688, 1911.

transformation, the substances just listed behaved as paramagnetic materials in that I was independent of H and $k \propto 1/T$. As the temperature falls there is continuity in passing from the paramagnetic state to the ferromagnetic state. No such continuity, however, seems to exist when one passes from the paramagnetic to the diamagnetic state, which suggests that the causes underlying the two states are quite different. So far this discussion has been largely historical and is given to serve as a background for a further discussion of the theories of Langevin and Weiss which have grown out of the researches of Curie.

Curie's work seemed to indicate that paramagnetic substances would give infinite susceptibility at absolute zero. This phase of the subject has been very extensively studied. Dewar and Fleming[5] found for solid $MnSO_4$ and liquid oxygen that it did hold down to —186° C. On the other hand the work of K. Onnes and Perrier,[6] Oosterhuis[7] and Honda[8] and Owen[9] seemed to show that Curie's second law is not at all true for the majority of paramagnetic substances and that furthermore a great many diamagnetic elements disobeyed the first law, viz., that they did not maintain a constant susceptibility as the temperature changed. Tables X. and XI. in the excellent paper of Dushman[10] show these discrepancies in a very striking way. These results have led Kunz[11] to remark that,

> It seems to me not justified to maintain Curie's rule, as there are many more exceptions than confirmations. The same is true for diamagnetism. . . . There are only very few elements which do not vary within the whole temperature range.

This weakens the foundation on which Langevin and Weiss build their theories for dia-, para- and ferromagnetism. The multitudinous works of those already mentioned with a host of others make it all too apparent that the phenomena of magnetism are exceedingly complicated. We must not, to quote Stradling,[12] expect too much of any explanation in view of the apparently contradictory facts. The theoretical and experimental investigations of Langevin and Weiss have been very productive of further experimental work and theory so that they must hold a very important place in the future development of magnetic theories. I can do no better than use the method of presentation given in the excellent résumés of the work of these two men which have been made by various English and American writers.

1. *Langevin's Theory of Diamagnetism.*—To begin with it is to be recalled that Rowland first demonstrated the fact that a moving charge created a magnetic field; if the charge moved in a circular orbit a magnetic field was produced normal to the plane of the path in which the charge moved. This forms a picture of electronic orbits which we suppose to exist in the flame for the Zeeman effect. If a magnetic field is thrown on to a group of such revolving charges, differences in period of revolution will be produced, in some cases decreasing and in others increasing the period. This gives rise to the double and triple lines which we see in the field of view of the spectroscope. This behavior of electronic orbits lies at the foundation of Langevin's and Weiss's theories. Thus according to Langevin if we introduce a substance into the magnetic field which is diamagnetic according to the tests we have already described, then the electronic orbits which we suppose surround every atom will be affected in the way we have just described them as being influenced in the Zeeman effect: some will have their periods decreased and others in-

5 Dewar and Fleming, *Proc. Roy. Soc.*, 60, 57, 1897; 63, 311, 1898.

6 Onnes and Perrier, Comm. No. 139a, Phy. Lab. Leiden. (See article Oosterhuis, *Koninklyke Akad.*, Amsterdam, 16, 892, 1913–14.)

7 Oosterhuis, *Proc. Amsterdam Acad. Sci.*, 16, 432, 1913–14. (Look up bibliography contained in this volume of the *Proceedings*.)

8 Honda, *Ann. d. Phys.*, 32, 1910.

9 Owen, *Ann. d. Phys.*, 37, 657, 1912.

10 Dushman, Reprint, *Gen'l. Elec. Rev.*, May, Aug., Sept., Oct. and Dec., 1916.

11 Kunz, Eighth Internat. Cong. App. Chem., 22, 187, 1912.

12 Stradling, *Journ. Franklin Inst.*, 180, 173, 1915.

creased. If the atom is built so that there are a number of electronic orbits so oriented that their resultant magnetic moment is zero then there will be no tendency for the atom as a whole to rotate, but on the application of the magnetic field there will be a tendency to alter the magnetic moment of each electronic orbit and no matter in which direction the electron is revolving the effect of the magnetic field is to create a polarity opposed to that of the applied field. If the magnetic moment of one electronic orbit is positive the effect of the external field is to decrease it and if the magnetic moment of another orbit is negative the external field acts to increase it so that the total effect is the same as that which we get from Weber's[13] theory of diamagnetism which assumes that there are no revolving electrons present to begin with but when a diamagnetic substance is exposed to a magnetic field, currents are set up in the atoms or molecules which develop magnetic fields having an opposite polarity to that of the inducing field. If the orbits of these circuits are resistanceless the currents will be maintained until the magnetic field is withdrawn again. It is to be noted that in the case of diamagnetic substances a finite magnetic moment is developed in the elementary unit with which we are dealing and which ought to have a corresponding tendency to rotate in a magnetic field. This point does not seem to be emphasized in the theory of diamagnetic substances, but as we shall see later on it is stressed in paramagnetic bodies. We know that an elongated portion of a diamagnetic substance does orient itself very definitely in a magnetic field. From the standpoint of the theory of diamagnetism just reviewed, diamagnetism must be almost a universal property of matter because we find the Zeeman effect in nearly all spectral lines of nearly all substances. We believe that the hydrogen atom has only one electronic orbit. Its diamagnetism is difficult to explain by Langevin's theory.

[13] Dushman, *Gen'l Elec. Rev.*, p. 20 of reprint from May, Aug., Sept., Oct., and Dec. issues, 1916.

2. *Langevin's Theory of Paramagnetism.*—

We have seen that in all cases the creation of an exterior magnetic field modifies the electronic orbits by polarizing diamagnetically all the molecules.

If the resultant moment is not zero, upon the diamagnetic phenomena is superimposed another phenomenon due to the orientation of the elementary magnets by the external field. The substance is then paramagnetic if the mutual action between the elementary magnets is negligible, as in the case of gases and of solutions and ferromagnetic in the case where the mutual actions play the essential rôles. As soon as the paramagnetism appears it is, as a rule, enormous in comparison with the diamagnetism and therefore completely conceals it. This explains the discontinuity between paramagnetism and diamagnetism; paramagnetism may not exist; but if it does, it hides completely the diamagnetism.

Therefore, substances whose atoms have their electrons in revolution in such a way that their effects are additive, are paramagnetic. The atoms of such substances may be looked upon as elementary magnets.

If we think of the elementary magnets at ordinary temperatures as being in a state of agitation then the tendency of the elementary magnets to orient themselves in a magnetic field will be opposed by the thermal agitation of the elementary magnets and they will settle down under a state of statistical equilibrium.

3. *Weiss's Theory of Ferromagnetism.*—Langevin has given a theory of dia- and paramagnetism and largely assumes ferromagnetism as a special case of paramagnetism. That ferromagnetism is a special case of paramagnetism will, I think, be conceded by all, but to explain more completely the phenomena attendant on ferromagnetism, Weiss has extended the theory somewhat by saying that to explain the varied phenomena as we find them, there must be associated with the turning of the elementary magnets something which acts like an extra magnetic field in addition to the external field applied. After considering all phases of the problem, however, and showing that he can explain many of the existing phenomena by means of this extra or intrinsic molecular field he is forced to admit that this "molecular field must be attributed to the

action of forces whose nature is still unknown." What must be the nature of these forces between elementary magnets? Weiss argues that they are neither magnetic nor electrostatic. These are questions to be left to the reader.

An attempt to correlate the many researches which have followed in the wake of Curie, Langevin and Weiss leaves the reviewer with a feeling of utter helplessness. The experimental work, in many cases, might well serve as examples of the highest type of modern physical research, but, when it comes to the various theories advanced, one must confess to a feeling that it is a good guessing contest in which one is as good as the other.

Out of Weiss's work, however, has grown a conception that seems destined to have some real meaning as we learn more concerning magnetic phenomena, that is, the magneton. Just as we have found that the electron seems to be the unit out of which we build all other electrical charges so here Weiss finds a similar analogy in that the magnetic moment per gram molecule of various substances seems to be small multiples of a common magnetic moment, equal to 1,132.5. Since we think of magnetic fields as due to moving charges can the magneton ever be so fundamental a concept as is the electron?

C. Seat of Magnetic Powers.—As we go over these various theories one is impressed by the recurrent words, orientation, rotation, revolution, change in magnetic moment, electronic orbits, etc., and then one begins to wonder as to how much magnetic phenomena really depend on these phases of the subject.

1. When a piece of iron, nickel or cobalt is placed in a magnetic field, what grounds have we for saying that the molecules, atoms or elementary magnets of the specimen are actually turned in situ by the external magnetic field? Does our affirmation of this question rest upon the fact that Ewing[14] once on a time pivoted a number of little magnets on needle points and showed how they behaved in a magnetic field and said this is the picture of a group of elementary magnets? Small magnets will turn on axes as Ewing showed they would and the logic is that the elementary magnets will also, but note that Ewing would have found hysteresis and B-H curves even if his little model magnets had not turned at all. Ewing's magnets did turn and the logic of the argument has tremendous confirmation in the work of Swinburne[15] who predicted as a consequence of Ewing's theory that if a piece of iron is rotated in a very strong magnetic field and the elementary magnets are held in alignment steadily as the iron cylinder is rotated there will be no changing from one configuration to another which may be unstable and thus dissipate magnetic energy into vibrational energy; consequently there will be a suppression of hysteresis. This was experimentally confirmed. Another verification is found in the experiment of Waggoner and Freeman[16] on the suppression of hysteresis by a longitudinal A.C. magnetic field, where the same kind of explanation as Swinburne's might be applied. This suppression of hysteresis seems to be closely associated with a certain degree of freedom to rotate, as for instance Rosenhain[17] points out that when an element whose atomic volume is greater than that of iron with which it is alloyed, the effect of the added element is to decrease the hysteresis. The increased atomic volume, from a mechanical viewpoint, makes larger interstices between the elementary magnets which permits of greater freedom to swing. If we have a theory to explain dia-, para- ferromagnetism then that same theory, in order to be a comprehensive magnetic theory, must explain all magnetic phenomena. At this point an outline might be introduced as an aid to keeping one's bearing when dealing with general magnetic phenomena.

14 Ewing, *Magn. Induc. in Iron*, etc., p. 348 et seq., 3d ed.

15 Swinburne, Baily, *Phil. Trans.*, 187, 715, 1896.

16 Waggoner and Freeman, *Gen'l Elec. Rev.*, p. 143, Feb., 1918.

17 Rosenhain, "Introduc. to Phys. Metallurgy," p. 110, 1915.

TABLE II

I. Induction Effects.
  1. Relation between field strength and magnetic induction, permeability, susceptibility, coercive force, retentivity, hysteresis, etc.
  2. Dia-, para- and ferromagnetism.
  3. Terrestrial magnetism.
  4. Alternating currents.
  5. Inductive effects as influenced by temperature, mechanic strains, aging, etc.
  6. Relation between susceptibility and chemical properties.

II. Mechanical Effects.
  (*a*) Reaction effects between magnetic fields.
    1. Attraction and repulsion of magnetic poles.
    2. Motion of electric conductors, solids, liquids and gases, carrying currents when placed in a magnetic field.
    3. Hall effect and its reciprocal relations.
  (*b*) Magnetostrictive Effects.
    1. Joule effect. Its reciprocal relations.
    2. Villari effect.
    3. Wiedemann effect. Its reciprocal relations.
    4. Volume change. Its reciprocal relations.
    5. Change in resistance due to a magnetic field.
    6. Production of sound.
    7. Piezo- and pyromagnetism.
    8. Magne crystallic action.
    9. Effect of magnetic field on thermoelectric phenomena.

III. Magneto-optical Effects.
  1. Faraday effect.
  2. Kerr effect.
  3. Zeeman effect.
  4. Magnetic double refraction.

Naturally one might question some points in this classification. Certainly changes would be made if we knew more about the subject. Whatever the arrangement of subjects a complete magnetic theory must explain all of the above phenomena. This is a real task. In particular, the present magnetic theories sidestep those phenomena listed above as magnetostrictive effects, which as the outline indicates is about half of the various magnetic effects. If the rotation of the elementary magnets due to an external magnetic field explains ferromagnetism then one may properly ask if the rotation of the elementary magnets might not also explain the magnetostrictive effects because these effects appear in ferromagnetic substances. Poynting and Thomson[18] have called attention to the fact that these magnetostrictive effects are yet to be explained on the molecular hypothesis. They state,

> It would obviously require some further assumptions as to molecular grouping or as to molecular dimensions in different directions.

The latter assumption has been a suggestive one and some progress has been made along this line, many of the magnetostrictive effects may be explained as being due to the orientation of elementary magnets whose dimensions vary in different directions. The work of Barnett,[19] Einstein[20] and deHaas and J. Q. Stewart[21] favors the idea of an orientation of the elementary magnet. Indeed our evidence seems very strong that rotation of the elementary magnets due to an external field is a part at least of all ferromagnetic phenomena.

The brilliant and highly significant work of the two Comptons[22] and their co-laborers[23] on the problem of the ultimate magnetic particle has a very important bearing on this phase of our discussion. Their interpretation thus far seems to argue against anything turning due to an external field unless it be something inside of the atom. If it is something inside of the atom it would seem difficult to explain the Heusler alloys or that bulk iron is ferromagnetic; while ferrous sulphate is paramagnetic and potassium fer-

18 Poynting and Thomson, "Elec. and Mag.," p. 201, 1914.

19 Barnett, *Phys. Rev.*, 6, 240, 1915.

20 Einstein and deHaas, *Verh. d. deutsch. Phys. Ges.*, 17, 152, 1915.

21 Stewart, *Phys. Rev.*, 11, 100, 1918.

22 Compton and Trousdale, *Phys. Rev.*, 5, 315, 1915.

23 Compton and Rognley, *Phys. Rev.*, 16, 464, 1920.

rocyanide is diamagnetic. No cataclysm of the atom has occurred in these chemical changes. On the other hand if we turn to magnetostriction for help in interpreting the work of the Comptons and explain magnetostriction as due to the orientation of the elementary magnets it would appear that their negative results may be due to the fact that they worked at only one field strength, whose value is not given in their papers, and at that field strength the orientation had not proceeded far enough to give measurable effects. For instance, in the case of an iron rod, as the magnetic field strength is increased from zero upwards, the rod first elongates and then shortens, becoming shorter at high field strengths than in its virgin state. At that field strength where the length once more becomes equal to the original length, at that point one would expect negative results in the work of the Comptons. In iron this field strength is about at the point where saturation occurs. From the magnetostrictive viewpoint the Comptons should find maximum effects at those field strengths where maximum changes in length occur. The Comptons used magnetite which is quite different from iron in the manner in which its length changes in a magnetic field. Yamada found that at several hundred Gauss field strength, it was still increasing its length and no maximum attained. The question may legitimately be raised as to whether the orientation of the elementary magnets had been carried on sufficiently to give the Comptons the effects they were looking for. A further study of the Joule effect in magnetite is being started to throw more light on this subject.

2. Would negative electrons revolving in orbits or negative electrons rotating, à la Parson, alone suffice as a picture of the elementary magnet? The theories we have so far discussed seem to convey the idea that they would. Why not attribute magnetic phenomena to a positive nucleus spinning on its axis? Barnett's work indicates the negative charge as the portion of the elementary magnet which is in motion. This does not, however, debar the positive nucleus from contributing some part of that property which we know as susceptibility and which we have been discussing. In other words induction may be a part of the property of the nucleus and we shift at least a part of that property from the mass to the elementary magnet.[24] What is it that gives magnetic characteristics? These are questions which our general subject of susceptibility raises. There are a number of items which, as it seems, bear upon these queries. Maurain[25] deposited thin films of iron and nickel and found he had to have a certain thickness of film before he obtained definite magnetic properties. For iron this was 8.3×10^{-8} cm. and for nickel, 20×10^{-8} cm. Wilson[26] in measuring the magnetic fields in a rotating iron cylinder arrives at the size of a magnetic particle as 10×10^{-8} cm. which checks fairly well. Hull,[27] working on the X-ray analysis of iron and nickel finds the distance of 2.47 and 2.50×10^{-8} cm. respectively as the distance between nearest atoms. These values seem to be commensurate. As already pointed out the spacing of the atoms seems to play a very important part in magnetic phenomena. Hull calls attention to the fact that it might be anticipated that ferromagnetic substances would have the same crystal structure. This is not true for iron and nickel are different according to Hull's observations. It is evident that ferromagnetism does not depend upon any particular arrangement of atoms but more probably upon distance between atoms which would explain the fact that this property is lost when the temperature is increased beyond a definite value. A center cubic arrangement may be more favorable to ferromagnetism, but is not a principle or essential factor. Arnold and Hicks[28] state:

> The elements giving iron high permeability and

[24] *Phys. Rev.*, abstract, Feb., 1911. *Phys. Rev.*, 34, 40, 1912.

[25] Maurain, *Jour. de Phys.*, 1, 151, 1902.

[26] Wilson, *Proc. Roy. Soc.*, 69, 435, 1902.

[27] Hull, *Phys. Rev.*, 14, 540, 1919.

[28] Arnold and Hicks, *Nature*, Apr. 17, 1902.

low coercive force are those which cause it to crystallize in large crystals.

Aston[29] also says:

> It seems true, other things being equal, that the heat treatment which will give to pure iron a coarseness of crystallization, and above all a uniformity and regularity of such structure will be accompanied by a low coercive force, and the effect of heat treatment is augmented by the addition of silicon or analogous elements, as arsenic or tin, all of which increase the coarseness of crystallization of the material.

It seems to be generally conceded that manganese is the essential constituent in the Heusler alloy. We don't know the magnetic properties of manganese any too well but its being associated so closely with iron, cobalt and nickel in the periodic system indicates the possibility of its possessing latent magnetism which under favorable conditions becomes active. Ross suggests that the presence of the other metals beside manganese exerts a helpful influence in making the manganese elementary magnets farther apart and so increasing its magnetic activity by the removal of the intense intermolecular forces which are supposed to act in the metal manganese. This point of view is further corroborated by the fact that the susceptibility of copper containing minute quantities of iron is far greater than that calculated from the amount of iron present. One of the most thorough researches undertaken on a phase of this subject was by Perrier and Onnes[30] who studied the susceptibility of a liquid mixture of oxygen and nitrogen and the influence of the mutual distance of the molecules of oxygen upon paramagnetism. In this work the oxygen at the low temperature is paramagnetic and inasmuch as the nitrogen did not enter into chemical combination with the oxygen it was possible to separate the oxygen molecules as much as desired by making the percentage of nitrogen larger. Their general results may be summed up by saying:

> The specific magnetization coefficient of oxygen becomes considerably greater, in proportion as the concentration diminishes.

There is much to be investigated along this line.

This discussion leads inevitably to the question as to where we shall locate the origin of the property of susceptibility? Will a group of electronic orbits account for magnetic phenomena or must we have added to their effect that which arises from the positive nucleus? Could we have a group of small coils to replace the group of little magnets with which Ewing once worked and obtain results such as he did? I have been working on this problem the past two years and so far have not been able to realize experimentally what Ewing did. It must be emphasized again that Ewing in his classical experiments worked with elementary magnets in which each elementary magnet itself showed all the properties which the group did. An attempt to explain the magnetostrictive effects on a molecular hypothesis makes it look very much as though one needed another factor to add to the electronic orbit to explain that particular field of magnetic phenomena.

Space forbids to give all the reasons why one is led to think of the atom as the seat of the phenomena we meet with in magnetism, or that the atom is the elementary magnet. The classical argument against this point of view is that the iron atom is ferromagnetic, ferrous sulphate is paramagnetic and potassium ferrocyanide is diamagnetic. Iron is a constituent of all three. Why this wide divergence of property? From preceding arguments it would appear that interstitial relations might answer the question. Oxley[31] put it another way by saying, in speaking of diamagnetism, that the molecular structure is distorted by the near approach of the other molecular structures so that the self induction of the electronic orbits is affected. The magnetic theories of Langevin and Weiss are essentially atomic theories and that the susceptibilities of the elements is

[29] Aston, *Trans. Faraday Soc.*, Vol. 9, July, 1913.

[30] Perrier and K. Onnes, *Proc. Roy. Acad. Amsterdam*, 16, 901, 1914.

[31] Oxley, *Phil. Trans.*, 214 (*A*), 109, 1914.—215, *A*, 79, 1915.

related to the atomic numbers in a definite manner is brought out by the curve which Harkins[32] has worked out and in a more striking fashion the curve given by Dushman[33] relating the logarithms of the susceptibilities of the elements to the atomic numbers. The curves showing these relations indicate a very definite tie between them and yet there seems to be no other properties associated with atomic numbers which are definitely related to the susceptibilities of the elements. May not this fact also emphasize the importance of placing some of the magnetic properties of the elements in the nuclei?

To come back to the field of magnetostriction it would appear from its teaching that in addition to electronic orbits, to explain magnetic susceptibility, *there must be given to the positive nucleus of the atom a property of induction just as Ewing had in his elementary magnets, and, for ferromagnetic substances at least, these nuclei ought to have different dimensions in different directions, capable of being rotated by means of an external field.*

Helmholtz once said,

> The disgrace of the nineteenth century is our ignorance concerning magnetism.

What shall we say of the twentieth century?

S. R. Williams

Oberlin College,
Oberlin, Ohio

FUNDAMENTAL PRINCIPLES ESTABLISHED BY RECENT SOIL INVESTIGATIONS

INTRODUCTION

The following is a brief review of the fundamental principles established by modern methods of soil investigation in the Bureau of Soils in the past twenty or thirty years:

TEXTURE OF SOIL

The first step taken established the fact of the general influence of the texture of the soil and its water-holding capacity on the distribution of the great classes of crops; that is, the general relation between the sand, fine sand, silt and clay soils and the general distribution of areas devoted to the production of truck crops, corn, wheat, hay and other heavy farm crops. This together with field studies of origin, mode of formation, and observable physical differences led to the mapping of soils, or the soil survey, which has been extended over a considerable part of the United States.

With the wide field experience it became evident that differences existed between different soil types or in the same soil type that were not to be explained by differences in texture or in water-holding capacity, but that yields vary with the practise of the farmer or from other causes, as was fully known and commented upon by the early Roman writers, that would need to be explained before the practise of agriculture, the application of fertilizers, and the handling of soils could be put upon a truly scientific basis.

ORGANIC CHEMISTRY OF SOILS

The study of some notably infertile soils and of very productive soils of the same type which had been held under what we call "better systems of farming" revealed the presence of certain toxic organic compounds in the one which were not present in the other. This led to a study of the organic chemistry of the soils. Finally we succeeded in separating from soils some 35 definite organic compounds, some of which were beneficial to certain crops and some of which were toxic to certain crops and nontoxic to others. It was also found that soils under a certain condition of aeration would yield certain organic products and under other conditions of aeration other organic products. It was found that the compounds separated from the soil were of the same nature as the compounds in the digestive system and in the blood of man and animal and it was finally realized that the soil has a digestive system as it were and breaks down organic materials such as the proteins, carbohydrates, and fats much

[32] Harkins and Hall, *Journ. Amer. Chem. Soc.*, 38, 210, 1916.

[33] Dushman, *l. c.*

as they are broken down in the digestive system of animals. The soil has the same kind of bacterial, enzymatic and oxidation processes as are common to the animals. It is evident that soil through these digestive agencies will take care of the excreta of plants and the organic matter that accumulates in the soil from various causes, reducing the organic matter to lower and lower forms of oxygenated bodies until they approach the hydrocarbon type of compounds in our humus, which are stable, innocuous and form the sewage disposal of the soil.

In the animal under abnormal functional conditions the too great accumulation of products of metabolism causes a fatigue of the muscles or if the system can not eliminate them the death of the animal. So under abnormal conditions in the soil brought about by adverse methods of cropping, of tillage, of the selection of crops, or improper methods of crop rotation the soil, as the French put it, becomes fatigued and the plant is unable to function.

The second stage of soil investigations therefore has developed the fact that the soil has a digestive system and is liable to fatigue or exhaustion as regards its power to produce crops and is dependent for its efficiency upon normal conditions, much as the animal is dependent upon normal functional activities to maintain life energy. This is a great field opened up for the organic and physiological chemist and bacteriologist. It may be stated more concisely that the chemistry of the soil is running parallel to the chemistry of the animal.

Some of the organic compounds isolated from soils and identified are as follows:

Acrylic acid,	Hentriacontane,
Adenine,	Histidine,
Agroceric acid,	Hypoxanthine,
Agrosterol,	Lignoceric acid,
Arginine,	Lysine,
Creatinine,	Mannite,
Cytosine,	Monohydroxystearic acid,
Dihydroxystearic acid,	Nucleic acid,
Glycerides, liquid,	Oxalic acid,
Guanine,	Paraffinic acid,
Pentosan,	Saccharic acid,
Pentose,	Salicylic aldehyde,
Phytosterol,	Succinic acid,
Picoline carboxylic acid,	Sulphur,
Resin,	Trimethylamine,
Resin acids,	Trithiobenzaldehyde,
Resin esters,	Xanthine.
Rhamnose,	

MINERAL CHEMISTRY OF THE SOIL SOLUTION

The mineral particles that make up the structure of the soil are bathed with a solution containing both inorganic salts and organic compounds. The circulation of this solution is similar in purpose to the circulation of the blood and it is upon this nutrient solution that the plant depends for its nourishment. It is particularly desirable, therefore, that the constitution of this nutrient solution be understood. By handling large quantities of soil in our laboratories it has been possible to obtain large quantities of this soil solution in dilute form. This solution, if allowed to evaporate quietly at ordinary temperatures yields successive crops of crystals which are found to be analogous to the salts found in the Stassfurt deposits of Germany and to the inland lake and sea deposits throughout the world. Silvite, kainite, and carnalite, the three important potash salts of Stassfurt, are commonly present in the nutritive solution of our soils, and, when we come to think of it, it appears to be the simplest thing in the world to understand that the salts that we value so highly in our mines are formed in our soils, transported through the oceans, and crystallized out again when the waters evaporate.

Our chemists have been expressing the results of their analyses in simple conventional terms of single salts. This work shows that the soil solution is most complex and that there are besides single salts, double salts and triple salts. In a complex salt solution changes of temperature or additions of material have a profound effect upon the character of the double or triple salts especially. No correlation has yet been made between these different complexes and the production of crops, or between these different complexes

and the effect of soluble fertilizer materials, or between these different complexes in different soil types, but the way has been opened for chemists now to study the soluble mineral compounds in the nutritive solution of the soil as never before.

The following list of salts has been identified in soils, or obtained from soils through the quiet evaporation of the dilute extracts until crystals appear.

Aphthitalite,	Leonite,
Aragonite,	Loweite,
Blodite,	Magnesite,
Borax,	Mirabilite,
Calcite,	Natrolite,
Carnallite,	Northupite,
Dolomite,	Picromerite,
Epsomite,	Soda niter,
Gaylussite,	Sodium carbonate,
Gypsum,	Sulphohalite,
Halite,	Sylvite,
Hanksite,	Thenardite,
Kainite,	Thermonatrite,
Kieserite,	Tri-sodium phosphate,
Langbeinite,	Trona,

Vanthoffite.

COLLOIDAL CHEMISTRY—THE ULTRA CLAY

This brings us down to the fourth great fundamental line of research which completes the outline of the problems to consider in future soil investigations and the most difficult of all to understand.

Always in our study of the texture of the soil, we have realized that there was something which modified the texture, something that bound the grains of soil together making certain soils very plastic when wet and very hard compact when dry and making other soils more friable and even incoherent when dry. It took us a long while to determine the cause of this plasticity. It was something that went obviously into solution but did not have the properties of a true solution. Finally we were able to separate it and found that it was a colloidal solution. From this we have prepared and collected the colloid itself, to which we have given the name ultra clay. The examination of this material leads us into the realm of colloidal chemistry which is a most difficult field to investigate because of the extremely inert nature of all materials in a colloidal state.

This ultra clay when dry will absorb as much as 200 times its volume of ammonia gas, from 20 to 40 per cent. of its weight of water vapor in a closed space over free water at 30° C. and in a wet state will absorb from 10 to 30 per cent. of its weight of certain dyes. By heating the ultra clay or an ordinary soil to 900 to 1000° C. this absorptive power is practically completely killed. By measuring the absorption of water vapor, of ammonia, and of certain dyes in the original soil, in the killed soil, and in the ultra clay separated from the soil, we have been able to estimate the amount of ultra clay in soils.

This ultra clay is as strong in its power to cement sand grains as is Portland cement, but when a dry briquette cemented by ultra clay is put into water it goes to pieces while a similar briquette of Portland cement holds its shape and crushing strength. When soil is heated to 900 or 1000° C. it loses almost completely its binding power when formed into a briquette, but if the amount of colloid estimated to be present by the methods already referred to is added to the killed soil the original plasticity is restored and the crushing strength of the dry briquette is about the same as in the original soil.

This colloidal material is disseminated through the soil as a film over the mineral grains, giving plasticity to the soil when wet, and hardness to the soil when dry, and is the medium for the absorption of gases, of organic, and of mineral matters. Physically it is analogous to the muscles and tendons of the animal body, which permits the articulation and motion of the skeleton and its fleshy covering in the animal; chemically it is analogous to the lining of the stomach and other digestive and respiratory organs of the animal and of the protoplasmic content of the vegetable cell. It appears to be essentially a silicate of aluminum and iron. We have not as yet been able to determine whether the small amount of lime, magnesia, potash, and soda present are a part of its constitution

or whether they are held there in colloidal form. The material is so inert in its chemical affinities that we have not yet been able to kill it or to control it in any material way except by heating. This is a matter of the greatest importance in the cultivation of the soil and is a matter of profound importance in road building as it appears to be the main cause of the deterioration and the breaking down of the modern road surfaces.

MILTON WHITNEY

BUREAU OF SOILS,
U. S. DEPARTMENT OF AGRICULTURE

SCIENTIFIC EVENTS

THE COUNCIL MEETING OF THE AMERICAN CHEMICAL SOCIETY

FROM the report in the *Journal of Industrial and Engineering Chemistry* we learn that Rumford Hall, Chemists' Club, was the gathering place on September 6, of the largest Council Meeting in the history of the society. President Edgar F. Smith was in the chair, and one hundred and sixteen councilors were present in person or by proxy. The business of the day consisted in large part of matters concerning the internal policies of the society, a complete report of which will appear in the proceedings in the October issue of the *Journal of the American Chemical Society.*

Two matters of national policy were discussed at length. The society's committee on patents and related legislation submitted a report on the Stanley Bill, now before the congress. The following resolution was unanimously passed:

> While the council is disposed to accept the views of its committee on patents, nevertheless it is felt that a constructive suggestion should be made by the committee as to legislation which would prevent the utilization of our Patent Office by foreigners for the suppression of the development of industries such as was so clearly apparent in the organic chemical industry upon our entrance into the war in 1917. The committee is therefore urged to consider this problem immediately and to report to the committee on national policies.

President Smith outlined the present legislative situation with regard to the organic chemical industry, whereupon it was moved that resolutions urging the passage of a limited embargo on synthetic organic chemicals be prepared for presentation to the general meeting on the following day.

It was decided to hold the annual meeting in September, 1922, at Pittsburgh, Pa. It will be remembered that this section relinquished its lien upon the September, 1921, date to permit the international gathering to be held in New York City. The spring meeting will be held in Birmingham, Ala., early in April, 1922.

The secretary presented an ad interim report of the finance committee and gave statistics regarding the paid and unpaid membership. It is estimated by the directors that the actual expenditures for the year 1921 will exceed the receipts by approximately $10,000.

The president of the Chemists' Club, John E. Teeple, presented a suggestion that the society take over the Bureau of Employment now run by the club, or establish a bureau to replace this organization. In accordance with the Council vote, the President appointed a committee consisting of H. P. Talbot, Edward Bartow, and A. C. Fieldner, to consider this question and report at the spring meeting.

Dr. Smith told of the work of the Priestley Memorial Committee, describing the Priestley portrait, and outlining the plans of the committee to establish a Priestley Medal fund. Plans are also under way for the restoration of the Priestley home at Northumberland, Pa., and President Smith spoke of his wish that the society might celebrate its fiftieth anniversary with a meeting at Northumberland in 1925.

THE OPTICAL SOCIETY OF AMERICA

THE fourth annual meeting of the Optical Society of America will be held in Rochester, New York, on October 24, 25, and 26. A large number of important papers dealing with all branches of optics will be presented. Several of the papers on the program will deal with the various phases of physiological optics. At this meeting a section on vision

will be formed to bring together in one society the workers in different fields on the various phases of physiological optics. In this way, better cooperation will be obtained between the physicist, physiologist, psychologist, and the artist. This year is the centenary of the birth of von Helmholtz and one session of the meeting will be devoted to commemorating his work in the fields of optics, sound, and electricity. An address on "Personal Recollections of von Helmholtz" will be given by Dr. M. I. Pupin. Visits have been arranged to the plants of the Bausch & Lomb Optical Company and the Eastman Kodak Company.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—SOUTHWESTERN DIVISION

There are being given this autumn under the auspices of the Southwestern Division of the American Association for the Advancement of Science a series of lectures on the history of the Southwest. They are being undertaken at the special request of the Frontier Scoutmasters' Association, with the approval and support of the El Paso Council of the Boy Scouts of America. The lectures are as follows:

October 5—The Ancient History of the Southwest as represented by the geological formations of the region: Professor W. H. Seamon, Professor of Geology at the Texas School of Mines.

October 12—The Ancient History of the Southwest as represented by ruins, stone implements, pottery and other remains: E. A. J. Seddon.

October 19—The Spanish Exploration of the Southwest: Mrs. M. D. Sullivan.

October 26—American Occupation of the Southwest: Dr. F. H. H. Roberts, principal of the El Paso High School and president of the Junior College.

November 2—History of the Mining Industry of the Southwest, from the earliest days: Lew Davis, of the El Paso Times.

November 9—History of Irrigation in the Southwest, from the earliest days on: T. H. Claussen, of the U. S. Reclamation Service.

November 16—History of Transportation in the Southwest: G. A. Martin, of the El Paso Herald.

November 23—The Indian Wars in the Southwest: Alvin E. Null.

November 30—The Present and Future of the Southwest: H. D. Slater, of the El Paso Herald.

The second annual meeting of the Southwest Division will be held in Tucson in the latter part of next January. It is expected that the meeting will be largely attended. There will be four scientific sections, instead of three, as at the last meeting. The Stewart Astronomical Observatory will be completed by that time, and Dr. Douglass hopes to dedicate it then as a special feature of the meeting.

Elliott C. Prentiss,
Chairman Executive Committee

THE TORONTO MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The engineering section of the American Association is arranging an important program for the Toronto meeting which will occur from December 27 to 31, 1921. The arrangements for the engineering sessions are in charge of Mr. J. B. Tyrrell, mining engineer, of Toronto. The programs aim to present the application of science to the solution of engineering problems. Many of the addresses will deal especially with the recent accomplishments of scientific engineering in Canada. It will be shown how scientifically trained men have developed some of the natural resources of the Dominion and the means by which this has been accomplished. Addresses already arranged are on the work accomplished by the Hydro-Electric Power Commission of Ontario; on the mines and mining plants of Canada including an account of prospecting in the northern wildernesses; on the explorations for oil carried out in the valley of the McKenzie River by the Imperial Oil Company, and on the work of the Toronto Harbor Commission in improving the Toronto harbor for the accommodation of ships of ocean draft. All of them, and especially those dealing with exploration in the far north, will be of interest not only to engineers but also to geographers and to every one interested in the out-of-doors. These ad-

dresses will generally be accompanied by illustrations and in many cases by motion pictures. Other topics will be announced later.

An exhibit of scientific apparatus will be a prominent feature of the forthcoming Toronto meeting of the American Association. Preparations for the exhibit are in charge of a special committee, resident in Toronto, consisting of Professor E. F. Burton, *chairman,* Mr. L. E. Westman, *secretary,* Professor F. B. Kenrick and Professor R. B. Thomson. The University of Toronto will provide space for the exhibits, and exhibits of non-commercial institutions and private individuals will be exempt from a small charge made to commercial organizations to cover expenses. Those who contemplate taking part in this feature of the Toronto meeting should communicate with the secretary of the special committee.

Reduced railroad fares for those attending the annual meeting of the American Association for the Advancement of Science at Toronto have been granted by four of the large passenger associations, which offer a rate of a fare and one-half, on the certificate plan, for the round trip. The railroad associations that have granted the reduced rates are: The Canadian Passenger Association, which includes practically all of the Canadian railroads; The New England Passenger Association, which includes the states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut; The Trunk Line Association, which includes the states of New York, Pennsylvania, Maryland, New Jersey, Delaware, Virginia (in part), West Virginia (in part) and the District of Columbia; and The Central Passenger Association, which includes the states of Ohio, Indiana, Michigan and Illinois. Effort is now being made to secure reduced rates from the other passenger associations. A complete list of railroads offering reduced rates will be given, together with instructions regarding the purchase of tickets on the certificate plan, in the preliminary announcement of the Toornto meeting.

SCIENTIFIC NOTES AND NEWS

Dr. E. D. Ball has resigned as assistant secretary of agriculture. He will remain at the department as director of scientific work.

Professor Mortimer Elwyn Cooley, dean of the college of engineering and architecture of the University of Michigan, has been elected president of the American Engineering Council of the Federated American Engineering Societies.

Sir William Pope has been elected an honorary fellow of the Canadian Institute of Chemistry.

Dr. Dwight C. Bardwell has left Berkeley, Cal., where he received his Ph.D. at the University of California, to accept a position as assistant physical chemist at the Rare and Precious Metals Station of the U. S. Bureau of Mines at Reno, Nevada. Dr. Bardwell will work under Dr. S. C. Lind on research problems presented by the radium at this station.

James E. Ives has resigned his position as research associate and lecturer in physics at Clark University to become a physicist in the office of industrial hygiene and sanitation of the United States Public Health Service. His headquarters will be in Washington, D. C.

Glenn E. Matthews has accepted a position as research chemist in the photographic department of the Eastman Kodak Co., Rochester, N. Y.

Director H. Foster Bain of the Bureau of Mines has appointed a board of engineers, consisting of Mr. M. H. Roberts, Dr. R. C. Tolman and Professor W. L. DeBaufre, to study the production of helium in Texas.

Dr. Louis A. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution of Washington, sailed from New York on October 5 to join the magnetic survey vessel, the *Carnegie,* at Balboa, Canal Zone. He will remain with her until the completion of the present cruise at Washington about the middle of November. Some special investigations are to be undertaken in the Caribbean Sea and Atlantic Ocean during the homeward trip.

Director A. A. Johnson, of the New York State Institute of Applied Agriculture, who was in Armenia to study conditions for the establishment of industrial and agricultural schools, and later went to Moscow by the request of Secretary Hoover to take charge of the food administration of the surrounding famine area, has completed his mission and has sailed for New York to resume his work.

Dr. Stephen S. Visher, a Bishop Museum fellow of Yale University, is studying hurricanes and their effects on man and on the distribution of life in the Pacific. He is now in the Fiji Islands.

We learn from *Nature* that an expedition to Sumatra, under the leadership of Mr. C. Lockhart Cottle, is to sail towards the end of the year for the purpose of making zoological and museum collections. A special effort will be made to obtain particulars of the life-history of the orang.

According to the *Journal* of the American Medical Association, Dr. August Hermeier Wittenborg, professor of anatomy in the medical department of the University of Tennessee, has been refused citizenship in the United States. Failure to register for service in the war was given as the reason for the withdrawal of Dr. Wittenborg's petition for naturalization. Dr. Wittenborg is a German by birth, but has resided in this country for several years.

Dr. C. R. Stockard, professor of anatomy, Cornell University Medical College, will deliver the First Harvey Society Lecture at the New York Academy of Medicine on Saturday evening, October 22, 1921, at eight-thirty. His subject will be "The Significance of Modifications in Body Structure."

The first meeting of the Physics Club of the Bureau of Standards for the season will be held on October 17. The speaker will be Dr. A. L. Day, whose subject will be "The Study of California Earth Movements." This is to be the first of a series of about ten lectures on the general subject of physical measurements pertaining to the earth. Meetings of the Physics Club are held on consecutive Monday afternoons at 4:30 in the assembly room of the east building of the Bureau of Standards and are open to all who may care to attend.

Mr. J. H. Jeans, secretary to the Royal Society, has been appointed Halley lecturer for 1922, at Oxford University.

The following lectures have been arranged for delivery at the Royal College of Physicians: The Mitchell lecture, on "The Relations of Tuberculosis to General Conditions of the Body and Diseases other than Tuberculosis," by Dr. F. Parkes Weber, on November 1; The Bradshaw lecture, on "Subtropical Esculents," by Dr. M. Grabham, on November 3; and the Fitz-Patrick lecture, on "Hippocrates in Relation to the Philosophy of his Time," by Dr. R. O. Moon, on November 8 and 10.

Dr. Arno Behr, a well-known industrial chemist, Perkin Medalist and charter member of the American Chemical Society, has died at his home in South Pasadena, Cal., in his seventy-fifth year.

As has been noted in Science the board of curators of the University of Missouri has voted to establish a four year course in medicine as soon as hospital facilities can be provided for clinical instruction. For a number of years the medical course at the state university has consisted of two years. We learn from the *Journal* of the American Medical Association that the extra session of the legislature, recently adjourned, appropriated $250,000 for the erection of a state hospital at Columbia for the purpose of providing clinical material for the medical students. It is expected that a similar sum will be appropriated at each session of the legislature until $1,000,000 has been appropriated for hospital facilities. The legislature also appropriated $200,000 for the erection of a new building for State Hospital No. 2 at St. Joseph.

On September 22, President Harding by public proclamation accepted and added to the present Muir Woods National Monument, California, 128.14 acres of land, a gift to the

United States from Mr. and Mrs. William Kent, of California, and from the Muir Woods and Mt. Tamalpais Railroad. The Muir Woods, a notable grove of redwood trees, became the property of the United States on June 9, 1908, when Theodore Roosevelt accepted 295 acres from Mr. and Mrs. Kent and proclaimed the area a national monument. Situated on the south slope of Mt. Tamalpais about seven miles in a direct line across the bay from San Francisco, it contains numerous redwood trees, reaching to a height of 300 feet and having a diameter at their base of 18 or more feet.

Nature states that a joint research committee has been formed by the National Benzole Association and the University of Leeds which will take over the direction of research in the extraction and utilization of benzole and similar products in England. The National Benzole Association is concerned with the production of crude and refined benzole, and, according to its constitution, one of its objects is to carry on, assist, and promote investigation and research. The term "benzole" is used in its widest sense, so the field of activity of the association embraces carbonization and gasification processes, by-product coke-oven plants, gasworks, etc., but at the present time it is concerned mostly with the promotion of home production of light oil and motor spirit. Success in this direction is thought to rest largely with chemical investigations into the possibilities of the various processes concerned, and it is with this object that cooperation with the university is sought. The joint committee which has been formed consists of equal numbers of representatives from the university and the association, and the initial membership is as follows: Professor J. W. Cobb, Professor J. B. Cohen, Professor A. G. Perkin, Professor Granville Poole, Professor A. Smithells, Mr. W. G. Adams, Dr. T. Howard Butler, Mr. S. Henshaw, Mr. S. A. Sadler, and Dr. E. W. Smith. Research work undertaken will be carried out under the supervision of Professor Cobb, and reports embodying the results will be published at intervals.

THE *British Medical Journal* writes: "At the request of the Surgeon-General of Trinidad, made through the American consul in that island, the surgeon-general of the United States Public Health Service has, with the consent of the Treasury Department, undertaken to send to Trinidad a quantity of the chaulmoogra oil preparation used by that service for the treatment of leprosy. The amount to be supplied will be sufficient for 500 treatments. The courtesy of the United States government departments concerned must be freely acknowledged; but the fact that the government of the United States was applied to by the medical authorities of an important British colony for this assistance appears to show that there is something lacking in the relations between the colonial medical authorities abroad and at home, and in the cooperation between the different British government departments, more particularly as the researches on the therapeutics of chaulmoogra oil in leprosy have been largely carried out by distinguished officers of the Indian Medical Service."

UNIVERSITY AND EDUCATIONAL NEWS

THE General Education Board has given Vassar $500,000 to increase the salaries of the faculty. Toward this sum $100,000 has been promised by Mrs. Edward S. Harkness on condition that $1,500,000 more be raised within two years.

THE new medical building of the University of Alberta has now been completed. The support of the people of the province has made possible the establishment of a well-manned and well-equipped medical school, which together with several closely allied hospitals can undertake the thorough education of medical and dental practitioners.

DR. JOHN LEE COULTER has been elected president of the North Dakota Agricultural College. He takes the place occupied by Dr. E. F. Ladd, who was elected to the United States Senate last March.

DR. P. W. WHITING, of St. Stephens College, Annandale-on-Hudson, N. Y., has resigned to take up work as associate research

professor of eugenics in the child-welfare research station of the State University of Iowa.

Dr. Ralph F. Shaner, for several years connected with the department of anatomy of the Harvard Medical School, has entered on his work as assistant professor of anatomy in the University of Alberta.

Dr. D. Burns, Grieve lecturer on physiological chemistry in the University of Glasgow, has been appointed professor of physiology in the University of Durham College of Medicine, Newcastle-upon-Tyne, in succession to the late Professor J. A. Menzies.

DISCUSSION AND CORRESPONDENCE

THE CAUSES OF WHITENESS IN HAIR AND FEATHERS

My attention has recently been called to a statement by W.D. Bancroft[1] to the effect that white hair and feathers owe their color to the entrance of air into their structure. Similar statements have appeared elsewhere at various times, and this conception appears to be widespread.

No one, to my knowledge, has ever presented any real evidence that either hair or feathers have any more air in them when white, than when colored. Furthermore it is quite unnecessary for them to have more air. I have never been able to see any difference in the structure of white hair and feathers as compared with colored hair and feathers, except for the presence or absence of pigment.

In 1904, I made the statement, in an address, that hair and feathers are white for the same reason that powdered ice or glass and other transparent substances in a fine state of division appear white.[2]

Hair consists of numerous cornified epithelial cells more or less *incompletely* fused together. In the case of human hair, most of the structure is cortical. These cells furnish a vast number of external and internal reflecting surfaces, as can be seen easily by placing a white hair on the microscope stage with no mounting fluid. When pigment is present, the incident light is more or less extensively absorbed, according to the amount of pigment, before reaching the deeper cells. The amount of undispersed light reflected, of course depends on the number of internal reflecting surfaces not screened by pigment. There is always some reflection of undispersed light by the hair cuticle, no matter how much pigment is present.

The white of feathers is produced mostly by the barbules which are of microscopic size and consist of single columns of cells.

Hair and feathers have many times the surface, external and internal, provided by small bodies of similar mass but less intricate structure. According to a well-known law, the surface of a cube varies relatively to the volume inversely as the diameter. Thus a cuboidal cell one tenth of a millimeter in diameter has ten times as much surface, relatively, as a body one millimeter in diameter. Furthermore, the amount of reflecting surface is increased by the irregular contour of the hair and feather elements. The total area of the vast number of facets in a single, unpigmented hair or feather which are in a position to reflect light to the eye is relatively very great.

White in hair and feather structures is due to failure or absence of pigment formation in the follicle before cornification takes place. I know of no critical evidence that either hair or feather structure can become white in any other way. The process is therefore slow, and the time required for a change to white is determined by the rate of growth.

Similar views are expressed in an article by Stieda[3] where a discussion of the origin of the notion that hair may suddenly become white is discussed in detail.

R. M. Strong

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[1] Applied Colloid Chemistry, 1921, p. 198.

[2] See abstract in *Biol. Bull.*, 1904, Vol. VI., No. 6, p. 311, for remarks about white feathers. See also *Anat. Rec.*, 1918, No. 1, p. 52, for discussion of white hair.

[3] *Verh. der Gesellsch. Deutscher Naturforsch. und Aerzte.*, 1910, Bd. 81, S. 222–224; also *Anat. Hefte*, 1910, Bd. 40, H. 2.

SIDEWALK MIRAGES

To the Editor of Science: A number of communications, published in Science during the past year, on "Sidewalk mirages" having recently come to my attention, I would like to add my experience with this phenomenon to those which have been related. I have driven over a stretch of road, part asphalt and part concrete, daily for the past two years, and have looked for mirages under every condition of the weather. Over the distance of the three miles of roadway I have marked every spot where the mirage occurs.

The nature of the road surface seems immaterial, but the effect of a "water surface" can be obtained wherever the level of the eye approaches that of the road surface. The mirage is not visible in cold winter weather and it is best during the very hot days in July and August. I believe that the intensity of the effect is unquestionably a function of the temperature of the road surface and the air immediately above it. That one observes a true mirage in this phenomenon and not a simple reflection can be demonstrated by the fact that an object "mirrored" on one of these surfaces will show an angle of incidence of probably 45° or greater, whereas the angle of reflection is, as stated previously by another observer, very small, approximating a few degrees only.

Mirror-like effects on asphalt roads are common, but have not the clarity of the images seen in a mirage, nor can mirror effects, due to reflection simply, be seen on a concrete road, so far as I have observed.

The position of the sun is of no influence, as mirages have been observed at the same spot at all times of the day.

Allan F. Odell

Carney's Point, N. J.

DISCOVERY OF A PREHISTORIC ENGRAVING REPRESENTING A MASTODON

To the Editor of Science: It may be of interest to you to learn of the recent reexamination of Jacobs' Cavern, a prehistoric rock-shelter located in extreme southwest Missouri, some three miles from Pineville, county seat of McDonald County. This cavern was examined by Dr. Charles Peabody and Mr. Warren K. Moorehead, of Phillips Academy, in 1903, report of their examination appearing in 1904 in Bulletin No. 1, "Exploration of Jacobs' Cavern."

Subsequent periodical and amateur investigations carried on by the writer, who now owns the land upon which this cavern is located, have resulted in the discovery of a number of very interesting artifacts. Chief among these are bone and horn awls, flint implements, engraved and polished implements of stone, and shaft straighteners and smoothers. Portions of an adult human skeleton, accompanied by an engraved sandstone pipe, have also been found.

The latest discovery was made on April 17, 1921, when the writer and Mr. Vance Randolph exhumed several engraved, perforated, and otherwise ornamented bones. These were apparently firm and sound but as a precautionary measure pen drawings were made immediately. Nevertheless, upon being examined a few weeks later, it was found that the bones were rapidly disintegrating. Immediate preservative treatment was resorted to but was so limited by local conditions that it was found impossible to save more than the most important specimen.

In many respects this bone is very interesting. One side bears an engraving which prominent archæologists have agreed seems to resemble a mammoth or mastodon. The reverse side bears two rows of parallel zigzag lines, lengthwise of the bone, the design corresponding closely with those found on the sandstone pipe. This design is also accompanied by another evidently intended to represent some member of the deer family.

The writer felt that Phillips Academy was naturally entitled to priority rights of reexamination of the cavern. However, Mr. Moorehead found it impossible to visit the cavern and recommended that Dr. Clark Wissler, of the American Museum of Natural History, make the examination. Dr. Wissler is now on the ground for that purpose.

Photographs of the most important specimens are in process of preparation and a

detailed report of operations will be made public as soon as practicable.

Jay L. B. Taylor

Pineville, Mo.

SOME SUGGESTIONS FOR PHOTOGRAPHING FOSSILS

For some time the writer, when photographing fossils, has used the whitening process contributed by Professor S. H. Williams, but, with many others, he has found it not altogether satisfactory. In order that the whitened specimen should contrast with a white background it has been necessary to over-expose or over-develop the prints. Because of this, many of the minor details of fossils have been lost in reproduction, and the pictures, as a rule, have seemed flat and "lifeless." In addition, it is usually the practise to opaque the background of the negative as an aid in determining how far to carry the development of the print. This process is painstaking and slow at best.

Some time ago, the writer, with the assistance of Mr. Parke Bryan, developed a slight variation in the photographing of whitened fossils that seems to be a decided improvement. The time required is materially shortened, in that the negative requires no opaquing, and the results are so gratifying in the way of improved reproductions that it seems worth while to outline briefly the method.

The method is a combination of the common lighting arrangement used in portrait photography, and the whitening process of Professor Williams. The specimen is mounted on a slender stick with modeling clay and then coated with a thin film of white. A dull white background, placed some distance behind the specimen, is turned at an angle such that it receives the full light but does not reflect it toward the camera. After the photographing table is orientated so as to give the conventional light direction and the desired light-shade contrast to the relief features, a screen is placed between the specimen and the source of light so as to intercept the direct rays. The screen consists of one or more thicknesses of cheesecloth sewed on a wire frame, the number of thicknesses depending on the intensity of the light. Every feature of the fossil now shows clearly on the ground glass of the camera, although the specimen appears dark against a pure white back.

It has been found that the shadows on the under side and away from the light source are more intense than the image on the ground glass indicates, and except in the case of relatively flat specimens it has been necessary to use a slight back reflection. A sheet of dull finish white cardboard held at the proper angle has in every case been sufficient for this purpose. If an actinometer is used to determine the time of exposure, it is obviously the light of the shaded specimen that is to be tested.

Maurice G. Mehl

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University of Missouri

SCIENTIFIC BOOKS

Vitamines: Essential Food Factors. By Benjamin Harrow, Ph.D. New York, E. P. Dutton & Co., 1921. Pp. 219. Price $2.50.

The author of this book has been at great pains to popularize a subject which the laity will certainly be glad to have so clearly presented. About half the volume is preliminary to the specific topic; it is a general account of nutrition and the story is well told. One is disposed to wonder whether readers who require such a very elementary introduction will appreciate the later chapters which are of necessity more difficult. However, a rare degree of order and simplicity is maintained to the end. The writer has a judicial attitude; he does not assert opinions of his own but quotes others with fairness and has evidently been in correspondence with the leading investigators that he may accurately express their views.

Of course not much space can be devoted to controverted matters in a book of this character. But a dogmatic tone is avoided. It should be plain to the reader that many problems await solution. Among the questions not fully settled may be mentioned the

following: whether rickets is due to lack of Fat Soluble A, whether there is an antiscorbutic vitamine (Water Soluble C), and in what sense pellagra may be rated as a deficiency disease. All the material is handled in a cautious and modest way with the result that no encouragement is given to faddists of any kind.

Percy G. Stiles

EXPERIMENTS ON THE RECORDING AND REPRODUCTION OF CARDIAC AND RESPIRATORY SOUNDS

We have recently conducted experiments at the Bureau of Standards in which permanent records of cardiac and respiratory sounds have been made and reproduced by the use of a telegraphone. The records have also been made audible throughout the room with the aid of audion amplifiers and a loud-speaking telephone.

A carbon telephone transmitter of ordinary type with a rubber adapter substituted for the mouthpiece was used for the stethoscope. The currents from the telephone transmitter were amplified by means of a five-stage audion amplifier which was connected to the recording element of a steel wire telegraphone. The magnetic records of the cardiac and respiratory sounds thus obtained were made audible by connecting telephone receivers to the telegraphone in the usual manner. The telegraphone currents were also amplified by means of a three-stage audion amplifier which was connected to a loud speaking telephone. In this way the sounds were made audible throughout the room.

This method of obtaining permanent records of cardiac and respiratory sounds and of reproducing them offers interesting possibilities in the study of normal and pathological conditions of the heart and lungs and their demonstration to an audience for purpose of instruction.

Franklin L. Hunt
Bureau of Standards

Magnus J. Myres
Medical Corps, U. S. A.

SPECIAL ARTICLES

THE SEPARATION OF THE ELEMENTS CHLORINE AND MERCURY INTO ISOTOPES

In Science of March, 1920, Harkins and Broeker reported that they had obtained a separation of chlorine into isotopes by diffusing hydrogen choride gas. The separation at that time amounted to an increase of atomic weight equal to 0.055 unit, or a change of density amounting to 1,550 parts per million. This separation has been definitely confirmed by Dr. Anson Hayes and the writer, who have secured an increase of 0.04 unit of atomic weight in a larger quantity of material. Elaborate purifications have been resorted to, and definite evidence has been secured to show that the increase in density found is actual, and not due to impurities. The details of this work were supposed to have been printed in the August number of the *Journal* of the American Chemical Society. However, since the date of publication of this number is doubtful on account of the printers' strike, it seemed advisable to answer here the considerable number of inquiries as to whether we have secured definite evidence of the separation.

About six months after our notice of the separation of chlorine into isotopes had been published, Bronsted and von Hevesy published a notice in *Nature* indicating that they had separated mercury into isotopes. However, since the extent of the density change reported by them was only about *one thirtieth* of that previously obtained by us in the case of chlorine, it seemed to us that the evidence for this separation of mercury was inconclusive, since a change of 50 parts per million in density might be due to minute amounts of impurities. In order to see if they could confirm these results, Dr. R. S. Mulliken and the writer have vaporized mercury at low pressures. The mercury was carefully purified by five fractional distillations in air at low pressures, and one in a high vacuum, after initial purifications with nitric acid. The increase in density obtained amounts to 69 parts, and the decrease to 64 parts or a total

change of density of 133 parts per million, or 0.027 unit of atomic weight.

The evidence that a separation has actually been obtained rests in the quantitative agreement between our results and those of Bronsted and von Hevesy, with respect to the rate of separation (efficiency of process). If we consider the efficiency of our more ideal apparatus as 100 per cent., that of the other investigators is 75 per cent. while that of our less ideal apparatus used in the greater part of the work in order to save the expense of carbon dioxide as a cooling agent, was 93 per cent. when the vaporization was slow, and as low as 80 per cent. for a rapid vaporization. We have obtained evidence that there is a slight separation of isotopes produced when mercury is *distilled* slowly at a sufficiently low pressure.

The rate of separation of two isotopes varies as the *square* of the difference of their atomic (or molecular) weights, and the product of their mol fractions, as the logarithm of the cut, and inversely as the atomic (or molecular) weight.

A diffusion coefficient has been calculated to represent the relative separation of isotopes attained in terms of the atomic weight change, when a definite cut is made. The values are 0.00843 for neon, 0.00868 for magnesium, 0.00450 for lithium, 0.00758 for nickel, while the experimentally determined coefficient for mercury is 0.00570. For chlorine the coefficient is 0.00950 for hydrogen chloride, 0.00690 for methyl chloride, 0.00494 for chlorine, 0.00413 for methylene chloride, 0.00295 for chloroform, and 0.00229 for carbon tetrachloride.

It is of interest to note that there are 9 isotopic forms of $MgCl_2$ (or more if there is a chlorine of atomic weight equal to 39), 7 of C_6Cl_6, and if mercury consists of 6 isotopes, there are 63 isotopic forms of Hg_2Cl_2. In addition to this most of the isotopic forms of C_6Cl_6 consist of a number of space isomers.

William D. Harkins

University of Chicago,
August 30, 1921

AN ARTIFICIAL NERVE

Physiologists are keenly interested in all attempts to discover an explanation or an analogy for the passage of the nerve stimulus. Most enlightening suggestions have recently been presented by Lillie[1] in his studies of passivity phenomena in pure iron wires. It seems that the transmission of the momentary wave of activity which occurs in a passive iron wire on activation in 70% nitric acid is closely analogous both chemically and electrically to the passage of the nerve impulse.

The general similarity of the two phenomena was apparently first noticed by Wilhelm Ostwald and subsequently elaborated by his student Heathcote.[2] In a paper published in 1907 under the caption "Transmission along a nerve" (p. 909) Heathcote writes as follows:

> In 1900, then, Prof. Ostwald called our attention to the possibility of nerve transmission being a process akin to the transmission of activity. . . . It is to be expected . . . that transmission of activity would be slower immediately after the first transmission owing to products of reaction around the iron. This has been confirmed by direct experiments in the case of iron in nitric acid. An effect of this kind in a nerve would explain the nature of "fatigue" so far as it concerns nerves.

After discussing the small amount of energy consumption in both transmissions Heathcote summarizes his conclusions as follows:

> There is nothing in the structure of nerve which renders it impossible to regard transmission as occurring in a way which is analogous to the transmission of activity along passive iron. . . . It appears possible too that the network in protoplasm may be a layer capable of transmitting changes in a similar way and which manifest themselves as an essential part of the mechanism of irritability.

It is not surprising that Heathcote's paper should have escaped the attention of physiolo-

1 Lillie, R. S., '18, Science, 43, 51; '20, *J. General Physiol.*, 3, 107.

2 Heathcote, H. L., '07, *J. Soc. Chem. Industries*, 26, 899.

gists. Lillie's independent rediscovery of this analogy, however, and his detailed studies and analysis strengthen the probability of a fundamental relation subsisting between the two phenomena.

The passage of the wave of activation over the surface of a short wire is so rapid, that it is not easily demonstrated to a large group of students. The simple arrangement here described is clearly visible at a considerable distance and has been used successfully as a lecture table demonstration.

Nine and a half meters of a ten-meter piece of number 20 piano wire are wound by hand on a machine lathe into a spring small enough to slip easily into a 100 c.c. burette. After stretching the spring sufficiently to insulate the individual turns, a glass tube is inserted in the spring and the remaining half meter of wire is returned through this tube. When

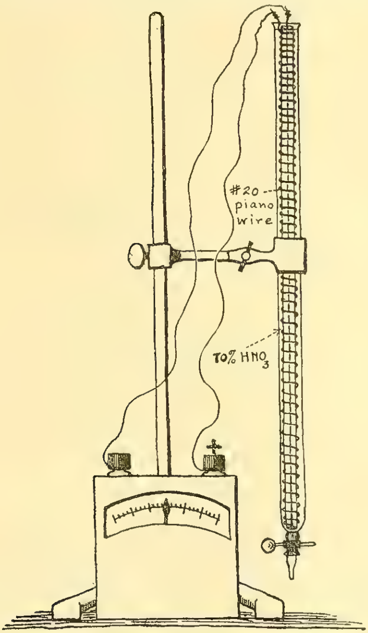

Fig. 1

set into the burette the upper end of this tube should just reach the burette top (Fig. 1). The two free ends of the piano wire are now connected through thin iron wires with a demonstration galvanometer or voltmeter which registers both positive and negative variations. After filling the burette three quarters with 70 per cent. c.p. nitric acid (by volume) the spring coil is lowered into it until about an inch of the lower end of the coil is submerged in the acid. The submerged inch of wire immediately begins to dissolve but if the coil is held in this position until chemical action ceases, the entire wire may be lowered into the acid without further action. In other words by passifying one end of a wire and then slowly lowering the remainder of that wire into acid the entire piece is passified. To prevent activation the wire must be lowered slowly and steadily. The coil is now ready to be tested at intervals with a zinc or copper "stimulus" applied just at the surface of the nitric acid at the top of the burette. After a somewhat variable latent period the entire spring becomes activated. The wave of activation passes down the coil and back through the return wire registering a diphasic "action current" on the galvanometer.

In its passage down the spring the activation wave sets free a shower of minute bubbles which change the color of the acid sufficiently to make the wave of activity clearly visible even at some distance from the preparation. This preparation recovers rapidly at room temperature and may be used repeatedly to demonstrate mechanical, chemical and electrical stimulation as well as the time required for the passage of a single activation wave over a distance of ten meters. At the close of the demonstration the coil should be removed from the burette, thoroughly rinsed in slightly alkine water and alcohol and rubbed briskly with a rough cloth. With these precautions it may be used repeatedly.

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THE AMERICAN PHILOSOPHICAL SOCIETY

II

Propylene glycol dinitrate: Charles E. Munroe. During the Great War not only was the demand for glycerine for use in making nitroglycerin greatly increased, but, as glycerine is normally produced from fats and oils which grew in demand for use in food, there was a special shortage in the supply. A promising substitute, though not a full equivalent for this, was found in propylene glycol dinitrate. Propylene glycol dinitrate is a nitric ester produced by the nitration of one of the isomeric forms of propylene glycol, which latter is the second member of the group of dihydroxy alcohols or glycols. The nitration of the glycol to produce this explosive is carried on in the same manner and with the use of the same acids as that of glycerine to produce nitroglycerine and the product has a similar appearance to the latter. The results of tests reported show that this propylene glycol dinitrate may be used as nitroglycerine is in the manufacture of dynamites and blasting gelatins. It is found to be less sensitive, to have a lower freezing point, to be decidedly more volatile, and to develop less strength than nitroglycerine, but in an emergency it may be efficiently used as an explosive, especially in mining and other industrial operations.

Further investigations concerning the relations between terrestrial magnetism, terrestrial electricity, and solar activity: Louis A. Bauer. The following chief facts have resulted from the present investigation: (1) The earth's average intensity of magnetism, as well as the strength of the electric currents circulating in the earth's crust, decreases with increased solar activity. The change between minimum and maximum sunspot activity in the case of the former may amount to six per cent. and more and in the case of the latter one hundred per cent. and more. (2) The atmospheric potential-gradient, or the deduced negative charge on the surface of the earth, increases with increased solar activity, the range in the variation between minimum and maximum sunspot activity being about 15 to 20 per cent. The electric conductivity of the atmosphere, on the other hand, shows but little, if any, systematic variations during the sunspot cycle. Accordingly, since the vertical conduction-current of atmospheric electricity is derived from the product of the potential-gradient and the electric conductivity, it is found that this vertical current increases in strength with increased solar activity; the range of the variation between the minimum and maximum sunspot activity is about 20 to 25 per cent. It would thus appear that atmospheric electricity, like terrestrial magnetism, is controlled by cosmic factors. These new results have an important bearing upon theories of atmospheric electricity. (3) Regarding the daily and monthly fluctuations in terrestrial magnetism, earth currents, and atmospheric electricity, as measured by the quantity, $H R$, where H is the intensity of the field and R the range in the element during the period considered, it is found that while in general, the magnetic and earth-current fluctuations increase with increased solar activity, the electric fluctuations, as shown by potential-gradient observations, apparently decrease with increased solar activity. (The latter result, however, should be regarded as but a preliminary one and it is receiving further investigation.) (4) Instead of using the sunspot numbers direct for comparison with magnetic and electric variations, it is found that a more satisfactory measure of solar activity may be based upon the monthly range of sunspot frequency, or upon the average numerical departure of the daily sunspot numbers from the mean of the month. In brief, there is indicated that a better measure of the radiations and emanations affecting the earth's magnetic and electric conditions is some quantity measuring the variability, or rate of change, in the sunspot numbers, rather than the numbers themselves. By measuring in this manner the variations in solar activity, and adopting a similar measure with regard to the solar constant values obtained by the Smithsonian Institution at Calama, Chili, for the two years 1919 to 1920, a good agreement, on the whole, is found between the two sets of measures of solar activity.

On mean relative and absolute parallaxes: Keivin Burns. This paper shows that the mean parallax of a group of stars, distributed at random, is 3.56 times the mean total proper motion divided by the mean total (uncorrected) radial velocity. By this formula the mean parallax was computed for the bright stars of each spectral class. The results are in good agreement with those obtained by Campbell, who used radial velocities freed from the motion of the sun and the tau components of proper motion. The newer method is much less laborious.

The mean parallax for those stars whose relative parallax has been observed was computed and the correction to reduce to absolute was derived. This was found to be 0.″010. This correction is the mean parallax of the comparison stars, which is in fair agreement with the value derived from the mean proper motion of these stars.

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THE DIRECTION OF THE EVOLUTION OF SCIENCE AND THE PLACE OF SIGMA XI IN SUCH EVOLUTION[1]

I RECENTLY read Professor Conklin's book "The Direction of Human Evolution" and his thesis so impressed me that I wish to apply his methods of analysis to-night to the subject of the evolution of science.

Dr. Conklin believes that the direction which human evolution will travel can be more or less accurately predicted by studying the path that evolution has already traveled and analyzing such knowledge so as to arrive at the basic laws which have governed the evolution of the past and presumably will govern the evolution of the future. Let us therefore apply his methods to the general field of science and view in retrospect the past and attempt to postulate the future.

When science actually began will probably never be known. It probably began in a rudimentary form soon after man evolved into a more or less intelligent being, for the discovery of the art of making fire was a scientific discovery of exceedingly great value to the human race. The recording of scientific observations probably goes back nearly to the beginning of written history, and when one contemplates the contributions of some of the earlier workers to science, one wonders whether or not we ourselves have actually progressed very far. We are accustomed to ascribe to Copernicus and his school the belief that the earth was not flat but a sphere and that it revolved about the sun and yet 1800 years before Copernicus was born Heraclites of Pontus (about 375 B.C.) stated that the earth revolved on its axis from west to east once in twenty-four hours and that the earth, Mercury and Venus revolved about the sun. Aristarchus of Lamos (about 270 B.C.) found

[1] Presidential address, University of Minnesota chapter of Sigma Xi, June 13, 1921.

that the poles were not fixed but oscillated in a circle and he fixed the diameter of that circle and the period of revolution so accurately that only the most modern instruments can detect the small amount that he was in error.

Perhaps the most noteworthy of the ancient scientists was Hipparchus of Rhodes (about 146 B.C.). He discovered the procession of the equinoxes due to a slight progressive shifting in the equinoxial points where the celestial equator and the ecliptic meet, and predicted, with almost modern exactness, the period in which the plane of the earth's excentric orbit would shift from maximum to maximum. He determined the length of the year within six minutes. He established the Tropics of Capricorn and Cancer within twenty-four miles of their present location and in order to do this he invented the science of trigonometry. Surely many a modern worker would have rested on his laurels after such a feat. Nevertheless he was not content to rest here but prepared a star catalogue of more than 1,000 stars, his list of constellations being the basis of the one used at present. One can but wonder what such a genius would have accomplished had he had modern instruments and libraries.

The few old manuscripts that are extant tell a wonderous story of science under Egypt and early Greece and we can only wonder how many more of the modern "discoveries" were known to the ancients. Conklin believes that human evolution reached its crest in the Golden Age of Greece, for he states that Greece produced more great geniuses in that period of 200 years than have ever been produced in a like period before or since. He believes that eugenically the Greeks at that time were a superior race and that inbreeding with their captive races and later with their conquerors has lowered, as it inevitably would, their potentialities for genius.

But modern science is not derived from the knowledge of the ancients. At no time in the ancient order of things was education the prerogative of every man. Knowledge was rather held to be the property of a secluded few and was passed on from the master to a few chosen disciples, so that with the advent of the Dark Ages the light of science soon died out until only a few sparks were left here and there. Meanwhile those nations which had stood foremost in the ancient learning became the vassals of other and less enlightened powers. The Alexandrian Museum, the repository of all the ancient lore, had been burned by the Turks, and many of the surviving manuscripts had been destroyed by the order of the Church. Consequently with the revival of learning men did not turn to existing knowledge as found in written form, but they began to construct anew the story of the earth and its natural wonders. We have thus two cycles of evolution from which to chose in drawing our analogy as to what the future may hold. Because of the fact that we know only fragments of the earlier story, it seems best to ignore it entirely and to draw our conclusions as to the future from the evolution of science since the Dark Ages.

One can not but wonder, however, whether such a catastrophe as the Dark Ages will ever again occur—whether our present knowledge will again be lost in fanaticism and bigotry. We hope and trust that such can never be, but when we think of what has happened in Russia within the past five years, when we read in SCIENCE of only last week how the foremost scientists of Russia are dying of hunger, cold and disease, how all scientific progress in that great nation has stopped, we can not be assured that another dark age will never come—we can only hope the tide will not sweep over the rest of the world. Had any one prophesied the present condition of Russia fifteen years ago he would have been laughed at as a dreamer, and we must remember that the Dark Ages of 400–1000 A. D. extended over a territory measured in square miles scarcely greater than that covered by the present scientific blanket of 1921. Only the wide expanse in which science holds sway at present has prevented a second "Dark Age."

The Revival of Learning following the Dark Ages was a slow and tedious process. The

search for the Philosopher's Stone and the Elixir of life retarded rather than furthered its progress, for the element of secrecy was all important upon such a quest, and science can not forge ahead under such a handicap. The scientist who prosecutes his studies from a selfish motive may personally succeed, but he can never hope to be listed among those names which are revered in later generations. When we think of the illustrious names which stand out in scientific history there is a remarkable unanimity in the fact that almost without exception they were pushing forward the field of knowledge purely for the joy that it gave them and not for fame or pecuniary reward.

The first great class of men to whom science owes an incalculable debt are the "naturalists"—men like Linnæus, Darwin, the Agassizes, Humboldt, who were at home in almost any field, and who have recorded observations on almost every subject. Dr. Woodward, former president of the Carnegie Institution of Washington, once said that science must pass through five stages:

1. The bug hunting, rock naming stage, *i.e.*, the observational stage.
2. The classification stage in which existing knowledge is put in order.
3. The experimental stage in which new conditions are imposed and new facts gained.
4. The theorizing stage in which the results of observation and experimentation are drawn together in the form of laws, and lastly
5. The mathematical stage—the expression of these laws of nature in mathematical formulæ.

The naturalists belonged largely to the first and second of these stages. To them we owe a considerable part of our present knowledge of the nature of the earth and its flora and fauna.

We can all appreciate the relative simplicity of the science of their time if we contemplate what they were able to do. Is there any one among you who would be willing to act as geologist, mineralogist, botanist, zoologist, meteorologist, anthropologist, archæologist, etc., on an expedition into an unknown land and who would guarantee that on the completion of the expedition you would undertake to write up the scientific results in such a form that the work would be a classic in all respects? I dare say not, and yet that was what the naturalists did. Science was in its infancy—almost every observation was new—and a genius could be authority in many fields. The day of the naturalist, in the sense that I am using it, has passed. Science is too complex.

We then pass to the experimental stage. Only a few years ago this was a new field of work. We began to tear down, to dissect, to study, to build up, and how much we have accomplished. In 1828 Wöhler prepared urea, the first "organic" compound to be artificially synthesized. The "organic" compounds were supposed to be created only by "organized" life. Since that time at least 150,000 organic compounds have been synthesized including the alizarine, which wiped out the cultivation of the madder in France, indigo, which threatened for a time to bring starvation to thousands in India because of the destruction of the indigo plantations, and even the "purple of Tyre," secreted by a mollusc, and which dyed the royal robes of ancient Asia Minor, has yielded its secret to the chemist, 1.5 grams of 6.6 di brom indigo being obtained from 12,000 shellfish. It can now be purchased in pound lots from chemical firms.

During this period of evolution science became more complex. The field of knowledge in which one could become proficient became more narrow. We have scientists who were authority only on chemistry, or on zoology, or on physics, or on botany, etc., but each had a very wide and complete knowledge of his chosen branch. To be sure when a professor was appointed to a chair in a university during this period he might be expected to lecture in a related or nearly related field. For example, the chemist might be expected to lecture on geology, mineralogy or crystal-

lography, the botanist to lecture on zoology, and the mathematician on physics or astronomy. Nevertheless specialization was beginning, science was growing.

To some of the younger members present, this period may seem to be long passed. Just as an illustration I may say that I received my first lectures in chemistry, geology, mineralogy and crystallography from one professor, and my physics and mathematics from another.

The next period succeeded in rapid succession—a professor was expected to be expert in only *one* science, but a chemist must know inorganic chemistry, organic chemistry, physical chemistry, analytical chemistry, assaying, etc., and what is more he was expected to teach all of these branches with equal facility and authority. The botanist must know morphology, taxonomy, cytology, bacteriology, physiology, etc., not only of one group of plants, but of all groups and teach and direct research workers in all branches, and so on for the other sciences. This period is rapidly passing and will soon be gone.

To-day we have narrowed our field. The mass of facts and theories in any branch of science has accumulated so rapidly, the scientific workers have so multiplied, that in a few years we will be fortunate if we can claim *authority* in a *narrow* branch of a *special* field. The evolution of the scientific journals is proof of this evolution. We have colloid journals for the colloid chemist, physical-chemical journals for the physical chemist, organic-chemical journals for the organic chemist, food journals for the food chemist, biological journals for the biological chemist, cereal-chemical journals for the cereal chemist, and so on *ad infinitum*. There is no end—there can be no end if science is to continue its evolution. The same situation holds for the botanist. They have their physiological and ecological journals. The physicist has those journals which specialize in radio activity, electricity, etc., and in the medical field there is possibly an even greater range of specialization than in any other.

Such is the situation to-day—where is it to end? It is not to end! As scientific workers increase in number, as the mass of scientific knowledge increases while the mind of man remains limited in the amount of information which it can properly assimilate, we must more and more become a group of specialists centering our intensive study upon a narrower and narrower field. The specialization that we have seen in medical science is only a special instance of the future of all science. The university of the future will have a professor of radium, a professor of the structure of the atom, and another professor of the α particle or the atomic nucleus,—yes, even a professor of the electron.

The time of the naturalist has passed, the time of the broad scientist is passing, the day of the specialist is dawning—has, in some instances, actually arrived. Science is sweeping forward with tremendous strides, and I do not envy the young candidate for the Ph.D. degree who 100 years hence will be required to search through the literature and compile a monographic history of the problem which he presents as his dissertation.

So much for my vision of the future. How is mankind to utilize to its best advantage the knowledge of these specialists fifty or one hundred years hence? How are the great problems of the world to be solved by men who can see only isolated trees in the great forests of nature? Probably the answer is cooperation. A problem will be attacked not by one worker but by ten, twenty or one hundred workers, who will pool their knowledge, their individuality, their selfishness and who will all work together for the glory of science and the good of mankind. Dr. Crocker, the director of the new Thompson Institute for Plant Research, recently said to me that he believed the day was not far distant when five or ten men would be permitted to present a single dissertation for the Doctor's degree, a masterpiece of research worked out in cooperation by the group, and into which each had put the best of his effort and manipulative skill. He has already so far convinced the graduate school of the University of Chicago that in one or two instances

one dissertation has been presented by two men working together. The big problems of biology are already too large for individual attack. We must have biologists, chemists, geneticists, statisticians, bacteriologists, pathologists—all working together to adequately solve them—and how much more rapidly science would advance if we could secure such cooperation! A specialist for every phase rather than a "Jack of all sciences" attacking the problem alone. And what part is Sigma Xi to play in it all? Sigma Xi if it is to play any part must yield to the processes of evolution or be passed in the race.

Sigma Xi was founded because scientists felt the need for a bond to draw them together and to propagandize in favor of science in the universities. In that day Latin, Greek, the languages and literature, history and philosophy, were the recognized collegiate courses. Science had not come into its own. What part Sigma Xi played in the establishment of science courses will probably never be accurately determined, but the day is already past when science needs any assistance in establishing its proper place in a university curriculum. Science has arrived! And with the evolution of science I am afraid Sigma Xi is being left behind. We no longer get together in scientific meetings to discuss the individual researches of science workers. Science has become too specialized. Many a university now has its chemical society, its pathological society, its society of clinical medicine, its physical society, its mathematical society, its botanical society, its physiological society, etc., etc. To be sure we call them seminars in many instances, but the result is the same. There are likewise new "Honorary" societies being formed, such as Phi Lambda Upsilon for chemistry, which have a special attraction for a special group. Where then is Sigma Xi's place in this new order of things?

If Sigma Xi is to live to fulfill the hopes of its founders it must meet the challenge of the new order with a definite mission. I believe that there is a place for Sigma Xi in the new order. It was created to foster science—why should its new mission not be to coordinate science, to foster cooperation, to be the guiding hand in establishing an *esprit de corps* among science workers, to attract to the universities noted lecturers in special branches of science, especially those branches which are the weakest in the university in question, to assist in the securing of the formation of special scientific bodies within the university, especially the honorary scientific societies of the special groups? For after all, it is the *specialist*, not the scatterer, who brings fame to a university. In short, Sigma Xi should be the keystone of the scientific structure and should devote all of its energies to those means which will advance the special sciences and which will draw scientific workers into a union so that they may attack the great problems of the future.

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THE RELATION OF CHEMICAL TRAINING TO INDUSTRY[1]

THE relation of chemical science to education and industry is no new problem. During the last few years a quantity of opinion and advice has been offered to us and, as one result at least, the fact stands out that there is need of adjustment between educational institutions training scientific men and the industries which these men are to serve.

Looking back historically, it seems evident that the present misunderstanding between the two great parties concerned arose because of the different points of view as to how (*a*) the results of scientific discovery, and (*b*) the young graduates in science prepared at our colleges and universities could best be utilized in industry. The teachers of science are often unfamiliar with the needs of industry in regard to the nature of the problems to be solved and in regard to the kinds of scientists needed in our highly organized commercial enterprises. On the other hand, manufacturers are often at a loss as to how

[1] President's address before the Kentucky Academy of Science, Lexington, May 14, 1921.

scientific men and discovery can best be utilized in industrial development and are apt to discount university research because it deals with pure science, the employer being unable to see the practical advantage to him of such work.

That this question is fundamental there is no doubt. One has but to glance over the advances made in any of our leading industries during the last twenty years to note and appreciate the importance of the scientifically trained man in, and his services to, our commercial organizations. In fact, when we mention coal and coal gas, dyes, explosives, cellulose, rubber, cement, pottery, photography, food, brewing, etc., our minds immediately refer to the great progress achieved recently in the industries because of the scientific worker. During the past few years scientific development of warfare has brought the pure and applied scientist together to an extent which was before deemed impossible, and this is a happy augury as to the future collaboration between these classes. The old isolation is now impossible and yet the question remains, as before, as to the best methods of training our graduates in science to fit them for industrial work. In other words, how can we best get team-work between the scientific producer and the scientific user? It has been said[2] that "the two fundamental essentials to successful team-work are an intelligent mutual understanding and a real spirit of give and take cooperation." The first of these will come with time, experience and education; the second may be discussed under the two following heads:

First, Industry and the College Graduate.—From opinions expressed by leaders in the industrial field, and from the questionnaires sent out by them concerning applicants for employment, it seems that the character, initiative and *resourcefulness* of the young graduate are valued by industry equally with technical knowledge. In many cases scientific training is considered the less important of the above characteristics. If this be true, it necessarily follows that an increased amount of time must be spent by the student in developing wide academic relationships. In other words a wide, basic training to develop observation, reasoning, imagination and character in general is essential. The fact that, in our educational processes, we are getting farther and farther away from this idea of a wide, basic training, does not need discussion. This is literally an age of intense specialization. The question asked by college graduates is not "what work will give me the best and broadest education" but "what courses will enable me to get the best paid job as soon as I graduate?" It seems to the writer that specialization in the secondary schools and the first two years of the college course should be reduced to a minimum and be devoted to a broad, basic education. Even when specialization is begun a knowledge of fundamentals and principles, together with an ability to apply them to any concrete problem, is of much greater value to the student than the possession of an endless chain of facts. Very happily this idea is becoming more and more popular with writers of chemical text-books and our courses, even in elementary chemistry, are less and less descriptive as time goes on. The same conception may profitably be applied to a selection of courses as well as to the material in any one course. Gas analysis is simply an application of quantitative analysis, and the student who has mastered the principles of the larger subject should be able to apply them to the former without taking a formal course in that subject. A knowledge of English grammar is more important to him than a course in water analysis if he has to choose between the two. Unfortunately, this point of view has been grasped neither by the student nor by many employers, though the results have shown the argument to be a sound one. In this connection it is interesting to note that one of our prominent eastern universities intentionally omits such subjects as water analysis from its courses required of men specializing in chemistry, stating that the time thus saved may be

[2] H. P. Talbot, *J. I. and Eng. Chem.*, Oct., 1920.

better devoted to other subjects such, for example, as instruction in the use of a chemical library. There is no doubt but that many of our graduates do not fully appreciate the fact that the final source of chemical knowledge is the chemical literature and they are not over familiar with methods for its use which assume a reading knowledge of scientific French and German together with required courses in chemical literature such as are now being given at the University of Pittsburgh. Surely such training can rightly be, and is, demanded of educational institutions by industry. Industry asks further that the college graduate be so trained that he can quickly comprehend the essential points in any research problem and separate the significant from the unessential. He should have a good grasp of experimental technique and detail and, paradoxical as it may seem in connection with commercial work, be able to work with small quantities as well as with large amounts of material. Since the success of most industries is dependent upon physical factors such as pressure and temperature, the research worker should be trained to watch for and detect the variable factors which are present and entering into his experiments.

It is not an easy matter to place the blame for the fact that the graduate does not meet the requirements stated above. The secondary school must be held accountable for some and the college for others. The secondary school does not sufficiently train the senses, so necessary to the scientist, but tends to develop the memory. Furthermore, the boy's curiosity is dulled even though this characteristic and the all important imagination go hand in hand. In college, often, the memory training continues instead of developing reasoning ability. The student relies implicitly and blindly on his text-book; without it he is lost. He is unable to stand on his own feet and replies, when given a reasoning question, that "it is not in the book." This is not a plea for the lecture system but is directed against the all too popular custom of memorizing printed pages. The technical school, also, is open to criticism because technical courses are often taught by those not in touch with industry.

The remedies for these conditions suggest themselves and no further comment on most of them is necessary except to state that even routine laboratory work may be made of value for research training by considering each preparation by itself as a research problem and treating it accordingly. Theories and principles may well be emphasized to the exclusion of some descriptive matter and their industrial application in many fields be pointed out.

To meet the objection that graduates have had no practical experience in industry the so-called cooperative courses of study have been organized in several institutions, notably the University of Cincinnati and the Massachusetts Institute of Technology. Under this plan the student divides his time between the university and some industrial plant, securing the theory at the former and the practical experience and handling of industrial apparatus at the latter. These courses are of five years' duration ordinarily and, being open only to students of ability, are fulfilling their mission successfully. This is one example of real cooperation between industry and educational institutions which is of direct advantage to the former. Another phase of this matter is that commercial organizations could, to their own benefit at a later date, employ high-grade college students during the summer vacation. These men, often of high ability, are many times prevented from graduating because of financial difficulties. Employment during the summer would furnish the necessary means for completion of the university work and the graduate would, upon taking his place in industry, more than repay it for the assistance rendered him. Thus the Standard Oil Company not only gives selected students employment during the summer months but, after the college course is completed, places them on salary in special schools where training for the future work is secured. Other large organizations have adopted the same plan with benefit resulting to both parties concerned.

Second, Industry and College Instructors.—As in the past, the research interest of the college instructor will always be in pure or abstract science and there can be but little doubt that this position is the correct one. Looking back over the development of industry it seems clear that research in pure science is the forerunner and always precedes industrial application. Though an investigation in abstract science may, at the time of its completion, be of no practical use to humanity, there is no reason to suppose that the time will not come when this research may be so utilized; in fact we have numberless examples of just such cases. Research in our educational institutions should be encouraged as much as possible, first, by the endowment of research laboratories and, second, by relieving as much as possible the research staff of an institution from teaching engagements in order that its members may have the maximum of time for investigation. When industrial problems arise which are in need of immediate solution, such institutions as the Mellon Institute of Industrial Research may be utilized in which a research problem of direct interest to an industry may be prosecuted, the firm deriving all of the benefits of the investigation and defraying its expenses. Commercial organizations may show their appreciation of research by endowing scholarships and fellowships in educational institutions and thus help to place this phase of educational work upon a firm, enduring footing. Industry ultimately benefits by research and therefore can logically be called upon to support it. An encouraging start has been made in this direction, many of our universities being the recipients of scholarships endowed by commercial organizations, thus assuring the research teacher of assistance and means to carry on his work. The question as to how the instructor can best keep in touch with industrial operations is not one easy of answer. He might well devote a part of his time to the solution of technical problems, thus gaining practical experience that would be of great assistance to him in his teaching. There are, however, at least two objections to this: (1) The results of such an investigation could necessarily not be published, because, as long as there is commercial competition, technical investigation will be conducted secretly and (2) there is danger of converting an educational laboratory into an adjunct to a commercial enterprise. This last is obviously an impossible situation and a misuse of public and private endowment given for educational use. Whether or not it will be possible to strike a happy medium only time can tell.

In conclusion, the report of a committee of the American Chemical Society[3] dealing with this subject is of interest. Briefly summarized it runs as follows:

"(1) The most important contribution which the universities can make to the industries of this country is to supply them with sufficient numbers of men thoroughly and broadly trained in the principles of chemistry.

"(2) Because of the tendency to draw men, effective in research work, away from universities into industrial work by the payment of higher salaries, it seems evident that, unless a considerable increase in salaries of teachers can be secured, the next generation of chemists is likely to be trained by a set of mediocre men.

"(3 and 4) Fellowships leaving the teacher and student free to select the topic of research as well as those designed to promote the solution of some industrial problem are both desirable. The results of the latter should be published and not be the property of any one firm.

"(5) Fellowships designed for the benefit of a single firm should be subject to very careful restrictions. The firm should pay for the services of the instructor as well as the fellow, and for the use of the laboratory facilities. The results should be published within two years after the expiration of the fellowship. Fellowships preparing men for specific industries are desirable provided the industry is a large one and the character of the training is left to the discretion of the

[3] *J. Ind. and Eng. Chem.*, May, 1919.

department. Emphasis should be placed on the broadest theoretical training. The holder of the fellowship should be free (not under contract) at the end of his period of study.

"(6) In passing on candidates for the degree of Ph.D., emphasis should be put on a thorough training in the fundamental principles of chemistry and upon high attainment in research, rather than upon period of study."

This is the present opinion on the question. Whether time will modify it we can not tell, but the suggestions outlined above, if rigorously carried out, will tend to bring about a closer cooperation between chemical science and industry than now exists.

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ANTHROPOLOGY IN THE MEDICAL CURRICULUM

The problem of human types is one that has baffled the ages, but it is at present in a fair way toward solution. The temperaments as depicted by Albrecht Dürer in the forms of four apostles, and as taught at the School of Salernum, based upon the four elements and upon the four humors of Hippocrates, and known as the melancholic, choleric, phlegmatic and sanguine, may not be generally accepted, and the phthisical and plethoric may have a greater significance, but until the physical and psychical types are studied upon a more exact and scientific basis the types of man may remain as myths to the laity as well as to the medical profession.

Manouvrier was the first to place the types of man as found among the Europeans upon an exact basis by actual measurement, and his classification into brachyskele, mesatiskele and macroskele, or broad, medium and long skeleton, is working its way into medicine. Godin has applied the methods of Manouvrier to children in the evaluation of growth with illuminating results. Others have utilized the same methods in the differentiation of races and in the segregation of types within the race.

The best means of differentiating human types is by anthropometry and inspection. The type may be decided by a careful inspection of the external form of the ear, nose, face, head and body form after one has become familiar with the types by prolonged experience. It is possible by the ear form alone to determine differences of 10 feet in the length of the small intestine, of 500 grams in the weight of the liver, of differences in the size of the brain, cerebellum, heart, kidneys and spleen, of the position and shape of the viscera; thus anthropology becomes the handmaid of anatomy in the medical curriculum, an essential adjunct in teaching medicine. Different human types represent different forms of intellect and different immunities and susceptibilities to disease, hence psychology and pathology become associated with anatomy and anthropology.

Adult human types probably represent the end products of chemical reactions that have been continuously at work throughout the life of the individual, or at least a large part of the life. It is only fair to assume that the net result of this activity will be easier to perceive than the chemical reaction at any particular moment. It may be fruitless to attempt to determine or differentiate chemical types, although the serum reactions may be so delicate that they will suffice to make clear minute differences.

Such a piece of work as that published in *L'Anthropologie* by Dr. L. and Madame H. Hirschfeld may interest physiologists, pathologists and internists. Serum tests were made during the Great War on about 500 soldiers in each of many national groups of Europe, of Asia and of Africa, and differences were found that amounted to more than 50 per cent. The tests were so acute and positive that individual heredity could be determined, the parentage of any child verified.

Dr. Goldthwait, in the Shattuck Lecture for 1915, presents the types of man as a basis for diagnosis and treatment, as do Percy Brown and Bryant. There is also an editorial in the number of the *Boston Medical and Surgical Journal* which has the Shattuck Lecture, wherein, with prophetic vision, the editor

states that some medical school will give a course in anatomy based upon human types, others will follow until the custom becomes universal. This has been done for the past ten years by the writer at Tulane or Virginia, and at both Western Reserve and Washington University, St. Louis, anthropology is a part of the medical curriculum in anatomy.

Human types have been studied in relation to medicine until physicians and surgeons are becoming familiar with their varied manifestations. Bryant, following Treves and others, calls the types carnivorous and herbivorous, as determined by the functions of the alimentary canal and diet. Chaillon divides the types into four from the physiological and clinical standpoint: digestive, respiratory, muscular and cerebral. Mills has two types of visceral form as determined through the X-ray by position, tonus and motility: asthenic and hypersthenic, each with subdivisions. It is not difficult to see the differences between the carnivorous and herbivorous types of Bryant, Treves and others; between the narrowback and broadback of Goldthwait; between the longskeleton and broadskeleton of Manouvrier; between the cerebral and digestive of Chaillon; between the asthenic and the hypersthenic of Mills; and between the hyperphylomorph and mesophylomorph of Bean; and it may be easy to demonstrate that all the couples are practically the same; but the psychologist, the physiologist and the pathologist must associate or dissociate the mental, the functional, the pathological and the physical.

The clinician may ultimately become familiar with human types by a process of assimilation through experience, but the necessity for the teaching of both race and type differences to medical students becomes more and more imperative. The proper place for the teaching of these subjects is in a laboratory of physical anthropology as a part of the medical course. At the beginning short practical courses in anthropometry and methods of inspection may be offered as optional work in connection with gross anatomy until such time as more complete courses may be given which should ultimately be offered as required work in a department of anthropology on a par with the courses in physiology, pathology or anatomy.

The physical and the psychical sides of man in relation to diagnosis, prognosis and treatment have been too much neglected in the medical curriculum, due in part to the enormous exacerbation of interest in germ diseases following the brilliant studies of Pasteur as to the rôle of bacteria in the production of disease. It is unnecessary to entail a discussion of the varying share of incitor and host in the production of disease, or upon the degree of immunity or susceptibility of the individual due to the physical or mental type or state. Once recognize the equal importance of the man and the germ, once understand the full value of the physical and psychical type and state, then follows as night the day the introduction of departments of anthropology and psychology into the medical curriculum.

Furthermore there are constitutional diseases, diseases of the blood and nervous system, and disorders of the mind not due to animal or vegetable parasites or germs of any kind, that need to be studied in relation to the physical and psychical type and state. The application of such knowledge is a field for the future in medicine.

Another field in which anthropology is potent is in that of growth. There is great need for studies in growth of races and of types, although Godin has blazed the trail in that direction, and these studies should lead the medical student to a thorough knowledge of the laws of growth, of the curves of growth of the organs, of the long bones, of the teeth and of the parts and structures of the body. A knowledge of the critical periods in the growth of structures is vital in medicine. This should be taught from the standpoint of race, and of type within the race.

We can not hope that anthropology will come into its own immediately as a separate department in the medical curriculum, which is already overcrowded, but let us hope that the study of the types of man will be pursued diligently in many directions, and that a place and time will be found in the medical curricu-

lum ultimately as the need and demand become imperative through the diffusion of knowledge.

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SCIENTIFIC EVENTS

THE FILM PHOTOPHONE[1]

The announcement in the *Times* of September 24 of the successful synchronization of speech and action in kinematography by means of photographic films bearing suitable sound records is the natural outcome of the work expended on this problem in numerous different countries. Sweden, through MM. Bergland and Frestadius, has apparently been fortunate enough to reach success first. It is indeed surprising that the achievement has been so long delayed. Speaking-films, apart from synchronization, have been in existence for a long time, having been first made by Ernst Rühmer about 1900, and called by him the "photographophone." Rühmer made his films by photographing upon them the fluctuating light proceeding from a "speaking arc," and the reproduction was effected by making use of the well-known property of selenium of controlling a telephonic current when actuated by variable illumination. More recently Professor A. O. Rankine has made speaking-films by a different method, in which the voice imposes fluctuations of intensity on a beam of light issuing from a constant source, the reproduction from the film record again being by means of selenium. The whole problem is closely related to telephony by light. In photo-telephony the speech is transmitted by light and reproduced immediately; in speaking-films a photographic record is made for future reproduction. The *Times* article does not make quite clear by what process M. Bergland makes the sound-film, but it probably does not differ fundamentally from those previously used. The novelty of M. Bergland's work appears to be the successful realization of synchronism between the picture-bearing and the sound-record-bearing films. This has been done by the obvious method of running the two films on the same shaft, both during the taking of the double record of action and speech and during reproduction. In addition, sufficient valve amplification to actuate a loud-speaking telephone has been successfully applied to the selenium-controlled currents.

[1] From *Nature*.

RADIUM FOR ENGLAND

Dr. Frederick Soddy, professor of chemistry in Oxford University, travelling as a King's Messenger, has arrived in London from Prague, bringing with him the largest quantity of radium, valued at about £70,000, ever brought into England. The consignment consists of two grams and is the first to be received under the terms of the recent agreement between the Imperial and Foreign Corporation of London and the Czecho-Slovakia Government. The radium was deposited at the Foreign Office and will remain there for the time being, its exact future, according to Professor Soddy, being a matter for negotiation.

Professor Soddy is reported in the London *Times* from which we obtain this information to have said that while on holiday with his wife in Czecho-Slovakia he visited the Joachimsthal mines and was given every facility for inspecting them and the various processes by which the radium was extracted from the uranium obtained in the mines. The agreement mentioned above having been concluded, he was asked by the Corporation, to whom he is the expert scientific adviser, to make arrangements for the transport of the radium to England, a task of considerable responsibility and some danger, in view of its malignant penetrative properties. The two grams were distributed in nine glass phials, packed in a lead case 3 in. thick and weighing about 70 lb. This was contained in an ordinary Foreign Office dispatch-bag, which was finally sealed by an official of the Czecho-Slovakia Government.

"I am sure," Professor Soddy added, "that this radium will be an enormous help to British science and medicine. It is of exceptionally pure quality. The cry of the

medical profession has hitherto been, 'We can not get enough.' The greatest amount I have so far ever had to work with has been 30 milligrams. There will be more shipments of radium from Czechoslovakia, but not necessarily to England."

It was explained that the radium will be lent freely for hospital purposes, and rented out to private practitioners. It will also be used for the production and sale of radio-active water in bottles, for use at radio-sanitoria, the production and sale of radio-active fertilizers, and for its by-products, such as polonium. The company expects to derive its first profits from the renting out of the radium emanations contained in capillary tubes, the price for the use of which at present is six guineas for 24 hours. One gram of radium supplies 4,500 of such tubes.

The Czecho-Slovak Legation in London has made public the following in regard to the contract entered into by the Czecho-Slovak Government, as the owners of the Radium State Mines in Jachymov (Joachimsthal), and the Imperial and Foreign Corporation of London:

> Under this contract the Radium Corporation of Czecho-Slovakia, a private limited company, has been established, the Czecho-Slovak state and the Imperial and Foreign Corporation holding equal interests. The Radium Corporation will obtain the loan for a period of 15 years of the radium production of the state mines, less a certain portion which is to be reserved for public use, especially for curative and scientific purposes. The radium so lent to the Corporation will remain the property of the Czecho-Slovak state.
>
> The contract does not contain anything relative to the working of the radium mines, which will be, as before, exploited by the Czecho-Slovak state.

BIOLOGY IN SOUTH CHINA

FRIENDS of Charles W. Howard, according to a report in *The Cornell Alumni News*, have lately received an account of the work in biology which he and his associates are doing in the Christian College at Canton, China. The work began in 1917 with a one-year course in introductory botany and zoology, taken by eleven students. By 1920–21 these had increased to 163 in seven courses, including plant physiology, plant pathology, evolution and heredity, economic zoology (entomology and parasitology) sericulture, and bacteriology.

The students taught are of three classes: those in arts and general science; those in agriculture; and those in medicine. All are required to take a course in general biology, which is popular and suited to the needs of those who will not go on. This is followed by a more technical course in botany, zoology and other branches as a foundation for further special work.

It has been the policy of the staff to keep as close as possible to research work and the practical applications of biology, for this is the way to make the students in the highest degree useful to their country. Much is yet to be learned about the insect pests and fungus diseases of crops in China. And Chinese farmers will soon be anxious for this information and ways of fighting their pests.

During the vacation trips the staff have begun a biological survey of the Canton Delta region. About a thousand species of insects have been collected, some of which are of economic importance. A herbarium of South China plants begun in 1916 by students of agriculture has been turned over to the department and is now one of the most important projects under its direction. While the herbarium has already over four thousand specimens, including more than twelve hundred species, only a beginning has been made. Expeditions must be made into the interior, and the whole of south China must be covered. Funds are needed for larger equipment.

Another line of work which has fallen to the department is sericulture. Silk is the largest industry of South China, forming forty per cent. of the export trade. Many things have held back the development of the industry. The filatures did not reel the raw silk in skeins of a size suitable for foreign manufacture. This has now been changed and modern methods have been introduced.

Later the department hopes to effect im-

provements in methods of beekeeping, fish culture, etc. It will strive constantly to meet the demands for the economic application of the branches of science it represents.

COMMITTEE OF THE U. S. DEPARTMENT OF AGRICULTURE ON LAND UTILIZATION

Secretary Wallace has appointed a committee of six scientific men of the Department of Agriculture to consider the entire problem of land utilization, especially with respect to the country's future requirements.

In appointing the committee Secretary Wallace suggested that as the basis of the work to be undertaken careful consideration should be devoted to the country's present crop production, home consumption and foreign demand, relating the land now under cultivation to present and near future demands. It seems to the secretary that this study should be followed by a more careful survey and classification than has yet been made of lands which can be brought under cultivation in the future, and the conditions necessary to make it profitable under the plow.

The suggested survey would include the arid lands of the West suitable for irrigation, swamp lands which can be reclaimed by drainage, and the cut-over timberlands of the various sections. In studying the cut-over lands consideration will be given to their possibilities both for cultivation and for reforestation.

The personnel of the committee of six is as follows:

Dr. L. C. Gray, agricultural economist, Office of Farm Management and Farm Economics, chairman.

C. V. Piper, agrostologist in charge forage crop investigations, Bureau of Plant Industry.

Dr. G. M. Rommel, chief, Animal Husbandry Division, Bureau of Animal Industry.

C. F. Marbut, in charge, soil survey investigations, Bureau of Soils.

E. E. Carter, assistant forester, Forest Service.

S. H. McCory, chief, Division of Agricultural Engineering, Bureau of Public Roads.

At the present time a little less than half the total national area is in farms, and only about one-quarter of the total area is improved land. Many persons, deceived by these facts, assume that there is an unlimited reserve supply of farm land. Such is not the case, however; by far the greater part of the 1,000,000,000 acres not yet in farms probably can never be used for the growing of crops, and plans must be made to use this land for the benefit of the nation.

THE DIRECTOR OF THE MELLON INSTITUTE

Announcement has been made by the board of trustees of the University of Pittsburgh of the appointment of Edward Ray Weidlein as director of the Mellon Institute of Industrial Research. Mr. Weidlein has been acting director since the recent resignation of Dr. Raymond Foss Bacon, and prior to that time, since 1916, he served as associate director. Dr. Bacon, who left to engage in consulting chemical practise in New York, succeeded Dr. Robert Kennedy Duncan, the first director and formulator of the institute's system of practical cooperation between science and industry, upon the latter's death in 1914.

Mr. Weidlein was a student of Dr. Duncan and later became an industrial fellow of the Mellon Institute. He has been associated intimately with the Industrial Fellowship System since 1909, and since 1916 has been a member of the administrative staff of the institute. He has had much experience in the supervision of industrial research and enjoys a national reputation as a specialist in the systematic investigation of the problems of chemical and physical technology.

Edward Ray Weidlein was born at Augusta, Kansas, on July 14, 1887. He was graduated at the University of Kansas with the degree of bachelor of arts in the year of 1909; in 1910 he received the degree of master of arts. He engaged in a study of camphor, under the direction of the late Dr. Robert Kennedy Duncan, and he carried out a comprehensive study of the ductless glands. From 1912 to 1916 Mr. Weidlein was a senior fellow in the Mellon Institute of Industrial Research, having supervisory charge of the institute's investigations on the metallurgy and hydrometallurgy of copper, and

having direction of the experimental plant at Thompson, Nevada. In connection with this work, Mr. Weidlein developed a process for the use of sulphur dioxide in hydrometallurgy.

In 1916 Mr. Weidlein went to the Mellon Institute as assistant director and was later appointed associate director. He became acting director in 1918, during the leave of absence of Colonel Raymond F. Bacon as chief of the Technical Division of the Chemical Warfare Service. In 1918 Mr. Weidlein was appointed chemical expert for the war Industries Board. The forty-eight industrial fellowships for scientific investigations of problems of manufacturing in operation at the Mellon Institute cover a wide range of problems in chemical and mechanical technology, and Mr. Weidlein maintains a constantly active supervision over these researches.

SCIENTIFIC NOTES AND NEWS

Dr. Simon Flexner, the director of The Rockefeller Institute for Medical Research, was elected honorary foreign member of the Academie Royal de Médicine in Brussels, Belgium, on June 25.

At a meeting of the board of directors of the Philadelphia College of Pharmacy, held on September 26, Rear Admiral William C. Braisted, former Surgeon General of the U. S. Navy, and formerly president of the American Medical Association, was reelected president of the college.

At the meeting of the Rochester Medical Association, held on October 3, at Rochester, under the presidency of Dr. Loron W. Howk, Dr. George H. Whipple, dean of the new medical school, University of Rochester, was entertained at dinner. In his speech he outlined the plan of the new school which was made possible by the gifts of the Rockefeller Foundation and of Mr. George Eastman.

Dr. L. L. Campbell, head of the physics department of Simmons College, Boston, has been elected a fellow of the American Academy of Arts and Sciences.

Dr. A. D. Bevan, past president of the American Medical Association, has received the title of Officer of the Legion of Honor for services rendered to medical science and education and as president of the American Medical Association during the war.

Dr. Ettore Marchiava, known for his researches on malaria, has been nominated an emeritus professor at Rome.

The Sultan of Egypt has conferred the Order of the Nile (second class) upon Mr. Owen Richards, director of the School of Medicine, Cairo, in recognition of valuable services rendered.

Dr. Norman MacLeod Harris, formerly assistant professor of hygiene and bacteriology in the University of Chicago, has accepted the position of chief of the division of medical research in the Department of Health of the Dominion of Canada, at Ottawa.

Dr. William C. Kendall, scientific assistant and ichthyologist of the U. S. Bureau of Fisheries at Washington, has resigned his position after thirty-three years of service, to accept the position of ichthyologist in the Roosevelt Wild Life Forest Experiment Station of the New York State College of Forestry at Syracuse. He takes the position made vacant by Professor T. L. Hankinson, who has accepted an appointment in the Michigan State Normal College, Ypsilanti.

H. L. Russell, dean of the college of agriculture in the University of Wisconsin and director of the Wisconsin Experiment Station and Agricultural Extension Service, has been appointed a member of the committee to manage the agricultural loan agency of the district for the War Finance corporation.

Dr. John Dewey, professor of philosophy in Columbia University, has returned to New York after having spent three years in the Orient, having been occupied as educational adviser to the Chinese government.

Dr. Albert H. Wright, of the department of zoology of Cornell University, spent a large part of the summer making a study of the animals, birds, and fishes in the Okeefinokee Swamp, lying between Georgia and Florida.

Dr. James E. Ackert, parasitologist at Kansas State Agricultural College Experiment Station, has resumed his work at Manhattan, after spending four months in hookworm investigations in Trinidad as a member of the expedition of the International Health Board of the Rockefeller Foundation.

Dr. N. J. Vavilov, professor of farm crops in the Petrograd Agricultural College and director of the bureau of applied botany and plant breeding is now in the United States on leave of absence to study methods followed in his field of work by American colleges and universities.

J. W. Richards, professor of metallurgy at Lehigh University, died suddenly on October 12, at the age of fifty-seven years.

UNIVERSITY AND EDUCATIONAL NEWS

A bequest of $200,000 to Harvard University, the income to be devoted to the investigation of the origin and cure of cancer, is contained in the will of the late Hiram F. Mills, the hydraulic engineer of Hingham, Mass. After numerous public and private bequests, including $10,000 each to the Massachusetts Institute of Technology and Rensselaer Polytechnic Institute, the residue of the estate is to be used to establish a fund for charitable purposes among mill workers in Lawrence and Lowell.

The *Journal* of the American Medical Association states that the foundations have been laid for the new University of Jerusalem, to which the Jewish physicians in the United States are giving $1,000,000 to build the medical college, of which the inside will be furnished in accord with American standards, with white tiled operating rooms, while the exterior will conform to the general plan of the university. Dr. Albert Einstein will be dean of the university, and an American surgeon, assisted by an American staff, will be at the head of the medical department. Patrick Geddes, professor of botany of the University of Edinburgh, has drawn up the plans for the building, which will be open to students from all countries.

Dr. Laurence J. Early has been appointed associate professor in bacteriology, and Dr. Percy Lawrence DeNoyelles assistant professor in pathology at the Albany Medical College.

Dr. Lester S. Hill, of the University of Montana, has been appointed associate professor of mathematics in the University of Maine.

G. Ross Robertson has completed his graduate study at the University of Chicago and has been appointed instructor in the Southern Branch of the University of California, at Los Angeles. While in Chicago Mr. Robertson also assisted Dr. Stieglitz in his Public Health Service work, as junior chemist.

Mr. C. A. Gunns, formerly zoological technician with the late Professor Sedgwick, of Cambridge University and the Imperial College of Science, London, and for the past five years in the same position with Professor McBride of the latter institution, has become zoological technician in the Department of Zoology, Kansas State Agricultural College.

Dr. David Hepburn, professor of anatomy and dean of the medical faculty, University College, Cardiff, has been appointed dean of the faculty of medicine in the University of Wales.

Professor O. Nägeli has succeeded Professor Eichhorst in the chair of clinical medicine at Zürich.

DISCUSSION AND CORRESPONDENCE

AN IDEAL HOST

To the Editor of Science: The following observation on the symbiotic relation between a large hammerhead shark and a shark sucker (Ramora) seems worthy of record. On July 5, 1911, a hammerhead shark ten feet two inches long and two feet seven inches across the head was taken in the Bureau of Fisheries trap in Buzzards Bay at Woods Hole, Mass. The shark was towed by the tail to the stone shark pool at the Fisheries wharf. After this strenuous trip from the trap my curiosity was aroused at seeing a small ramora about sixteen inches long clinging to the side of the shark. So far as I could discover no one had seen the ramora either in

the trap or in the shark pool. Mr. Vinal Edwards tried to catch the ramora with a dip net whereupon, to our surprise, it swam quickly towards the shark's head and, with a peculiar twist of the tail, entered the posterior gill slit on the right side of the head and disappeared, presumably into the shark's mouth. It seems possible that the ramora made the trip from the trap in the same way. In this case therefore the shark offered free transportation, food and shelter, making him practically an ideal host.

Reynold A. Spaeth
Woods Hole, Mass.

A REMEDY FOR MANGE IN WHITE RATS

Everyone who has kept a colony of white rats under laboratory conditions has doubtless been confronted with the necessity of dealing with the mange-like skin disease which affects the edges of the ears, the nose, tail and the skin of the body. The organism is one of the species of Notoedres, the itch and scab mite.

The conventional remedy in this laboratory has been a mixture of sulfur and vaseline but I have had no success with it. Recently, Kennedy[1] reported the use of cedar oil for this disease but cautioned care because of its anesthetic properties.

I have had satisfactory results with a 2 per cent. solution of chloramine-T. The crusty scabs on the ears, tail and among the hair on the shoulders are rubbed vigorously with cotton soaked in the solution and usually yield to such daily treatment in less than a week. The peculiar long horny growths on the nose are best treated by cutting close with a sharp scissors and treating the resulting lesion daily with the antiseptic. Routine sterilization of cages is desirable in any case.

After surgical operations the rats often insist on removing the sutures with their teeth. Treatment of the wound twice daily with chloramine-T solution will give satisfactory closure in a very short time.

Arthur H. Smith
Sheffield Laboratory of Physiological Chemistry, Yale University

[1] Kennedy, Science, N. S., 53,364, 1921.

QUOTATIONS

THE TECHNICIANS IN INDUSTRY

The Society of Technical Engineers has just published a journal in which its position and policy are for the first time clearly defined. This society represents a movement of great interest, which has for some time been quietly advancing, but has attracted very little attention, either general or official. It has not escaped the notice of employers or of trade unions, who regard it with mingled feelings, and intelligent students of industrial affairs have carefully noted its rise; but since it has made no stir the public have heard nothing of it and official circles have turned a blind eye on it. Yet it marks a large change in the evolution of industry. The technicians, as represented by the Society of Technical Engineers, are not only engaged in industry, but are an essential factor in its largest branches, and one continually and rapidly advancing in importance with the development of applied science. More than any other element, they hold the key to the economic future in the field of practical operations. In a sense, this has been recognized by the immense amount of attention devoted to technical education in recent years. The backward state of technology in this country and the wonderful superiority of our industrial rivals were incessantly pressed upon British manufacturers before the war, but the importance attached to technical training was not extended to those who receive and apply it in practice. They have been taken for granted as part of the industrial apparatus. This was conspicuously shown during the war. Employers and labor leaders were constantly taken into council, and distinctions have been lavished on both, but the technicians, who had far more to do with the actual business of producing munitions than either, were wholly ignored. So, too, they are habitually overlooked in industrial inquiries, conferences, disputes and conciliation machinery. In the discussion of industrial relations and economic problems the old categories of Capital and Labour, never adequate and now quite out of date, are still

used. It is not perceived that a class has arisen which fits into neither, but is equally important, and, indeed, less easily replaced than either.

It is overlooked because it has not asserted itself. Now that this society has given a lead by settling its policy and position, the movement may be accelerated. It has decided not to join either employers or trade unions, but to occupy an independent and intermediate position, and, while protecting its own interests, to cooperate with both in promoting the advancement of British engineering industries. This decision is of great interest from several points of view. It will not please employers or trade unions, but we believe that it is sound and to the public advantage. An independent organization, powerful from the indispensable part in industry played by its members, and standing between employers and workmen, in intimate touch with both, may come to possess a decisive influence in holding the balance between them. The engineers, in particular, have a unique position which differentiates them from the clerical blackcoats, who do not come in contact with the manual workers. At the Engineering Conference held last July Mr. John Brodie, President of the Institution of Civil Engineers, referred to this in connection with industrial disputes, and suggested that the engineers, as a technical body, were peculiarly fitted by their knowledge of workmen and impartial standpoint for the investigation and judicial treatment of differences. This is a promising line of development.—*The London Times.*

SCIENTIFIC BOOKS

History and Bibliography of Anatomic Illustration in its Relation to Anatomic Science and the Graphic Arts. By Ludwig Choulant. Translated and edited, with notes and a biography, by Mortimer Frank, B.S., M.D. With a biographical sketch of the translator and two additional sections by Fielding H. Garrison, M.D., and Edward C. Streeter, M.D. The University of Chicago Press, Chicago, Illinois. xxvii, 435 pages.

In 1852 Dr. Ludwig Choulant published his indispensable history of anatomical illustration. Although neither an anatomist nor artist, being a professor of medicine addicted to bibliography, he made both anatomy and art his debtor, even at the cost of some impairment of character. For, adoring the antique, he became the outspoken opponent of new doctrines in medicine, ridiculing the sound methods of physical examination, and was, in the words of his biographer, "the foe of progress." Although like all before him he deprecated book-wisdom and authority-worship in others, yet his own career shows the danger of these siren studies —of regarding, for example, the thirteenth the greatest of centuries, or of unwisely inquiring, "What is the cause that the former days were better than these?" However, Dr. Choulant does not extol the past in his impassionate historical record, and it is quite possible that his biographers, from whom we have quoted, have dealt with him unkindly.

In the preface he sets the limits of his work. It is not intended to be a history of anatomy, or of anatomists, or even of anatomical discovery, but merely of *anatomical illustration,* following two lines—that of scientific anatomy and that of artistic anatomy. The study is further restricted to the anatomy of man in its most obvious features. Many of the illustrations are of the human skeleton, and most of the others show the superficial muscles or general disposition of the viscera, so that the frontier of anatomy alone is entered. From Choulant's viewpoint, perhaps, Dr. Garrison writes that "anatomical illustration was neglected through the growth of histology, morphology, and embryology."

The author proceeds, in a historical introduction, to define three stages and seven periods of anatomical drawing. Although this chapter contains much interesting exposition, the proposed stages and periods are chiefly of academic interest. It is followed by a very brief account of ancient and mediæval illustrations, with a superb chromo-lithographic reproduction of miniatures from a manuscript of Galen's *Opera varia.* After this the anatomist-artists and artist-anatomists together are presented chrono-

logically, with terse comments and compact data on as much of their work as is relevant. This involves tireless research and great bibliographic resources, and is an instance of what we like to regard as typical German scholarship. The illustrations were supplied by a publisher, Rudolph Weigel, personally devoted to the graphic arts, who "came to love this enterprise." They are well executed woodcuts, copied from important and generally rare originals, and since the pages are usually foxed, the book itself, though not old, has the flavor of antiquity. That it would suffer from an artistic standpoint in an American edition would be expected, and such is indeed the case. The miniatures in color and the red-chalk drawing are replaced by gray half-tones, many more of which with their muddy backgrounds and occasional obscurity of essential details have been introduced. The woodcut facsimiles in Choulant appear as "process" line-drawings, since it was recognized that this would give better results than photographic copies from worn and library-stamped originals.

Dr. Mortimer Frank has made a very able translation, rendering into English not only the German text, but Latin, Italian and other quotations. He has expanded greatly the accounts of certain authors, increasing that of Mondino, for example, by seven pages; and owing to Sudhoff's researches he could supplement Choulant's brief treatment of early manuscript illustrations by a large and separate chapter, which becomes discursive and quite different from Choulant's work. It raises the question whether the Alexandrian school of anatomy produced anatomical drawings, now lost, which were the source of the crude figures found in Provençal, Persian and Thibetan manuscripts. These figures have in common, among other things, a sitting or straddling posture; all of them may have come, according to Cowdry's recent publication, from still earlier Chinese sources, but the drawings which he has found to substantiate this show little more of anatomy than a strange posture. It seems probable, however, that anatomical illustration had a long history before the renaissance, little of which may ever be known. The mediæval pictures show further that Jacobus Sylvius was not without some justification in making his great mistake, namely that because the physician must, as he said, view and handle the body, anatomical pictures would always be a hindrance "serving only to gratify the eyes of silly women."[1] Thus one very able anatomist lost a place in any history of anatomic art, but it seems unnecessarily severe to describe his pupil's achievements as "tremendous and limitless"; nor should the anatomist Marc' Antonio Della Torre, who employed Leonardo for making illustrations, be lost in the effulgence, when Leonardo "steps to a place of intolerant central glory."

Great anatomists who neither made pictures nor had them made for them, are rigidly debarred; whereas others of relatively slender attainments but given to pictorial illustration appear of magnified importance. None more so than Casserius, whose ornate drawings of the vocal organs of all creatures from sheep to crickets, in folio plates with floral festoons and turnip embellishments, mark the beginning of the "fourth period." Count is made, however, from his work on general human anatomy. Concerning the Casserian plate chosen by Dr. Frank to replace an immodest selection in Choulant, Dr. Garrison writes as follows:

> It represents an eviscerated female figure, of lovely proportions, apparently floating in mid-air, in the rapt, ecstatic attitude of some transfiguration scene of Raphael or Corregio. In sheer beauty, this figure is comparable with the robust goddesses in the Aurora Fresco of Guido Reni in the Rospigliosi Palace at Rome.

A comely woman, surely, but one attached to earth though her feet are below the limit of the picture! On the whole we prefer the description of these plates by Holmes, written with his poetic license and abandon:

> In the giant folio of Spigelius lovely ladies display their viscera with a coquettish grace implying that it is rather a pleasure than otherwise to show the lace-like omentum, and hold up their appendices epiploicæ as if they were saying, "these are our jewels."

[1] Dr. Frank Baker, in the Johns Hopkins Hospital *Bulletin*, Vol. XX., 1909, p. 332.

In Chirurgeon Browne's "Compleat Treatise of the Muscles," 1681, which is not mentioned by Frank or Choulant, these same plates appear, strangely metamorphosed. Dissected gentlemen, wearing wigs of the period, are placed like dancing statues on absurd pedestals, and one lacerated creature has been transferred from the bare ground to a bed.

Much graver omissions are inevitable in a book of such wide scope, but it is thankless to refer to them in view of all that the authors have accomplished. It is a pleasure to see a reproduction of Wirsung's very rare first picture of the pancreatic duct, even though it probably has suffered much in reduction and printing. This, we believe, is the only figure of an original plate illustrating an important anatomical discovery which the volume contains.

The three appendices introduced in this edition are a fragmentary treatment of Chinese anatomy by Choulant, an interesting treatise on sculpture and painting as modes of anatomical illustration by Drs. Garrison and Streeter, and ten pages by Garrison, chiefly an annotated list of books, concerning anatomical illustration since the time of Choulant.

The whole volume is designed as a memorial of Dr. Mortimer Frank, who died at the early age of forty-four—a kindly, modest and able student of medical history whose work is of permanent value.

F. T. Lewis

Observations on Living Gastropods of New England. By Edward S. Morse, Peabody Museum. Pp. 1–29, pls. I.–IX.

There are so few papers describing and figuring even the external features of the animals of mollusks, that all students and lovers of this group will hail with pleasure the paper whose title is given above. It is a companion piece to the one published two years ago by the same author, "Observations on Living Lamellibranchs of New England." In the present paper 46 species are figured in 118 sketches gathered on 9 plates. The first 22 pages are given to a discussion of the anatomic structures figured, while the last 7 are devoted to an arraignment of modern nomenclatorial methods.

There is only one criticism that we have found covering the first 22 pages and plates, in fact this has been discovered by Professor Morse himself, as stated in a letter to me by him. This concerns figure 18 which shows an appendage in *Aporrhais occidentalis.* This represents an abnormality and should have been eliminated or designated as such.

Some may criticize the doctor for retaining an ancient nomenclature and may even go so far as to say that had he spent as much time in revision as he did upon the preparation of pages 23 to 29 he might have saved some one else the task of bringing the names up to date and rendered his observations more readily available to the general public. I have gone over the revisional work and shall publish the results in the *Nautilus.* In so doing, I may say that I have been greatly aided in disposing of some of the questions of identity of West Atlantic with East Atlantic species by the anatomic data presented in this paper.

Finally, we would fail did we not remind Professor Morse that he was one of the pioneers who by his careful studies, so long ago, showed that some of the large groups then in use, were complexes requiring the splitting which he fearlessly bestowed upon them. He should not forget the shock delivered to no less a celebrity than the elder Agassiz when he pointed out that Brachiopods were not Mollusks, as heretofore held, but animals more nearly akin to certain worms. These, however, were conclusions based upon structural characters and merited that recognition and welcome which such discoveries will ever find accorded to them. The lamentable nomenclatorial changes are those which are occasioned by preoccupation. I have frequently wished that some organization could be prevailed upon to undertake the preparation of a card catalogue of scientific names, generic and specific, beginning with Linnæus, giving in addition to the name and citation of publication, the family to which a given genus belongs, and the type locality for each species. In the case of secondary combination, a cross reference card should be pre-

pared for filing under the proper places. Such a work carefully executed would eliminate at once almost all the changes in nomenclature due to priority only, the names, that seem to irritate most grievously the men who are not actually engaged in revisional work.

The reviser usually has only one aim, or should have only one aim in mind, and that is to achieve stability by applying the rules of the international code consistently, no matter how much he may dislike to do so. No nomenclatorial stability can be achieved if each of us follows an independent method. A catalogue of the kind above referred to would make a quick revision possible, the main points of which would stand for a long time to come, and the minor shift could easily be kept current by the small force that should prepare the cards for the new things published year by year. I wish to heartily recommend this undertaking to the National Research Council. I am sure that the whole zoological fraternity, yes, not only zoological but botanical fraternity, would be grateful for such a work.

It is to be hoped that Professor Morse will continue this work and will find time to give us the results of his efforts.

Paul Bartsch

VENOMOUS SPIDERS

My attention having recently been called to the death of a man, apparently from the bite of a spider (which case will be described below), I have brought together some of the literature upon this much debated question, and I shall quote from several authorities upon the subject.

Comstock, in "The Spider Book," makes the following statements in discussing the venomous character of spider bites:

> During my study of spiders I have collected thousands of specimens and have taken very many in my hand but have never been bitten by one (p. 213).
>
> Several of the more prominent arachnologists, including Mr. Blackwall, of England, and Baron Walckenaer and M. Duges, of France, have made experiments to determine the effect on man of the bite of spiders. Each of these experimenters caused himself to be bitten by spiders; and all agree that the effects of the bites did not differ materially from those of pricks made the same time with a needle (p. 214).
>
> I have given considerable attention to this question with the result that I firmly believe that in the North at least there is no spider that is to be feared by man.
>
> Although we have in the North no spider that is to be feared, it is quite possible that in the South it is different. I confess that I should not like to be bitten by one of the larger tarantulas of that region, although I know of no well-authenticated case of a person being bitten by one.
>
> The spiders of the genus *Latrodectus*, of which we have a common representative in the South, are feared wherever they occur, and it is possible that they are more venomous than other spiders. . . .
>
> This genus, as has been well stated by F. P. Cambridge, comprises those very interesting spiders which, under various local names, have been notorious in all ages and in all regions of the world where they occur on account of the reputed deadly nature of their bite. It may be added that this belief is not shared by students of spiders . . . (p. 357).
>
> This species (*L. mactens*) is very common and widely distributed in the South. It is found under stones and pieces of wood on the ground, about stumps, in holes in the ground, and about outbuildings . . . (p. 358).
>
> Although it is essentially a southern species, it occurs in Indiana, Ohio, Pennsylvania, New Hampshire and doubtless other of the northern states. . . . It also occurs in California (p. 358).

An apparent inconsistency is seen in the above quotations. He states in one place "that in the north at least there is no spider that is to be feared by man." A little later he says:

> Although it (*Latrodectes*) is essentially a southern species, it occurs in Indiana, Ohio, Pennsylvania, New Hampshire, and doubtless other of the northern states. . . .

Since he reports *Latrodectes* from Pennsylvania and New Hampshire it is obviously not an entirely southern species.

Long before the publication, in 1912, of "The Spider Book," in Vol. 1, 1889, of *Insect Life*, the editors, Riley and Howard, discussed in two articles, the question of spider bites.

In the first of these, "A Contribution to the Literature of Fatal Spider Bites," various cases are reported, one of which was fatal in fourteen hours. They call attention to the fact that the genus *Latrodectes,* under various local names, in widely separated parts of the world, has the reputation of being poisonous; it is even classed, in this respect, with the rattlesnakes, by some Indian tribes. This very widespread reputation would seem to be fair evidence in favor of the view that this spider has marked poisonous characters.

After discussing the above-mentioned cases, the authors make the following statement:

. . . it seems to us, after analyzing the evidence, that it must at least be admitted that certain spiders of the genus *Latrodectes* have the power to inflict poisonous bites, which may (probably exceptionally and depending upon exceptional conditions) bring about the death of a human being (p. 211).

In a later communication, "The Spider Bite Question Again," in the same volume of *Insect Life,* the editors quote a letter from Dr. E. R. Corson, of Savannah, Georgia, in which four cases are described in detail of supposed bites from spiders, though in no case was the animal actually captured or seen. Two of these cases were adult colored men; one was a very strong, healthy white man; the fourth was a two-year-old boy. None of these victims died, though some of them were most seriously affected, the symptoms being practically the same in each case as those to be described below for the two cases under discussion. As in these two, and practically every case recorded, the victims were bitten on the penis while using an outdoor closet.

U. L. Kellogg[1] in an article entitled "Spider Poison" discussed the subject of bites from *Latrodectes* in a most interesting manner. He quotes the same statement from Comstock, given above, in regard to the skepticism of students of spiders as to the serious nature of their bites; and he says

To this I may in turn add that at least one student of spiders, though incomparably less experienced than Comstock, does share the belief in the unusually poisonous nature of *Latrodectes mactens.*

The chief case cited by Kellogg is one that he quotes from one of his former students, Dr. Coleman. It will be noted that in this case the spider was captured and identified as *L. mactans.* The case is as follows, in Dr. Coleman's words:

Patient B came to my office one morning at 8.15 o'clock, showing signs of an acute poisoning of some sort.

The glans of the penis had been bitten by a spider while the patient was sitting in an outcloset. The only thing felt was a sharp sting. (The spider was captured, so there is no doubt as to the species; it was a female of *Latrodectes mactens.*) In about ten minutes there appeared dizziness and weakness of the legs, followed by cramps in the abdominal muscles.

The patient left the field where working and started to walk to town, a distance of a little over a mile. The pains grew worse and the penis started to swell and turn red. When the office was reached, the pains, of a cramp-like character, in the abdomen, were intense, also around the heart and thighs. Physical examination showed the heart to be running at a rate of 40 per minute, of small volume but regular. The respiration was labored. The pupils were dilated and the face very red and congested. The penis was swollen to a great size, fully three inches in diameter at the glans, and the color was a mottled purple. The contractions were clonic in character, giving the greatest pain in the chest and abdomen. There were no pains below the knees or elbows.

The treatment consisted of hypodermic injections strychnin 1/40, followed in ten minutes by nitroglycerine 1/100. Local applications to the site of bite of the crystals of potassium permanganate. The heart went as low as 27 beats to the minute. After three hours' work, using repeated injections of strychnin, the heart-rate was increased to 45. The pains were not quite so severe and the patient was taken home. The administration of strychnin was stopped and the use of brandy hypodermically injected was substituted, a dose of 10 mm. being given every hour. Heat was applied to the feet and back. At 5 P.M., or about nine and one half hours after the first symptoms, the heart-rate had been raised to 55 and then as the pains were still severe, a ¼ morphin with 1/150 atropin was given. The pains eased up and the patient dropped

[1] *Journal of Parasitology,* Vol. 1, 1915, pp. 107–112.

The next morning a fine rash appeared all over the body, accompanied by some itching. The penis had returned to nearly normal size. The heart-rate was 60, the respiration was 18 and deep, temperature 100. The rash disappeared in four days. The patient was troubled with insomnia for several days, and a stubborn constipation that took a very active purge to affect. . . .

Dr. Coleman also tried various experiments with spider poison, both upon himself and upon lower mammals; two of these are as follows:

Several experiments were tried on rabbits and cats with very interesting results.

1. The dissected glands of one female *Latrodectes* containing the virus. The virus was macerated in 10 drops of distilled water. The same was injected subcutaneously into the abdomen of a cat about 8 months old. In about five minutes a series of convulsions set in of a clonic type, quickly followed by tonic spasm and in ten minutes the animal was dead.

3. A quantity of the eggs of *Latrodectes* was macerated in 20 gtts. of water and diluted up to 10 c.c. The injection of this solution produced the same typical symptoms and death to a cat 8 months old in about three minutes. A rabbit was killed in about two and one half minutes. . . .

It will be noted that the spider poison or "arachnolysin" is not confined to the poison glands but is found in the body fluids and tissues as well. Kellogg says:

A diadem spider of 1.4 gr. contains sufficient poison to destroy completely all the corpuscles in 2.5 liters of rabbit blood. This puts arachnolysin in the class of strongest kinds of blood poisons.

He says also:

Probably with *Latrodectes*, as with other animal poisons, the physiological idiosyncrasies of the particular man bitten play an important part in determining the degree of seriousness of the trouble produced.

The most recent case brought to my attention, by the sister of the victim, occurred in Oklahoma in the summer of 1920. The victim was a strong healthy man of thirty-eight; he died about thirty-two hours after being bitten, in spite of the efforts of three physicians. All three of the doctors were written to for details of the case, but only one Dr. E. W. Reynolds, responded. His description of the case, so far as he knew it, follows.

I was called on the case shortly after Mr. L. was bitten. He had gone to the toilet and while sitting on the stool felt something like a pin stick him but did not look until he was bitten again and then discovered a little black spider which he killed. . . .

He was bitten on the end of the penis and I could not see any marks or swellings which probably meant that he received the poison directly into a small blood vessel.

When I saw him he was in great agony. The pain traveled up the penis through the cords to one group of muscles and another, shifting about all the time. The usual amount of narcotic had no effect at all. I was with him about one hour but did not get to see him again. He could not lie still, and when I left he was some easier and not depressed. When I left I expected to have to go back later and give him another hypo but wanted to wait awhile to see what effect it already had.

For some reason later other doctors were called but I understand were unable to help him in any way.

It will be noticed that in this case also the victim was bitten on the penis while using a toilet, and that a "little black spider" was killed.

It would seem worth while for the public in general, especially in the rural districts, to become familiar with this rather formidable little animal, whose colors and markings make it easy to recognize.

Since writing the above I have received from Dr. V. L. Casto, the father of one of my students, the following history:

On the 30th day of last October I was called to see Andy Coon, age 48, farmer and American, who about two hours previous to my visit was bitten by a small spider, black in color: he had been husking corn and had noticed several small black spiders in the fodder and one of them seemed to get tangled in his underwear and bit him four times, about five inches above the left ankle.

I found him in the following condition: suffering excruciating pain radiating from the place of the bite to the top of his head; the leg swollen, a severe pain around the heart, pulse 140 per minute, and in about 30 minutes the pain passed to the opposite side and the left leg and thigh began to swell and he began to swell over the region of the

kidneys; at this stage he began to vomit and went into collapse and broke out into a cold and clammy sweat, remaining this way for two hours.

He continued to swell for 12 hours, when it stopped, and it was 48 hours before the swelling began to leave and six weeks after the bite the patient still complains of soreness in his legs and some pain around his heart, yet he is able to resume his work on the farm.

Also, since writing the above, an article has appeared in the *Journal* of the American Medical Association for January 8, 1921, page 99, by Dr. D. J. Lewis of San Juan, Coahuila, Mexico, entitled "Black Spider Poisoning; a Report of Four Cases." In this article he briefly describes the cases of three men, aged respectively 31, 32, and 33 years, and of one woman, aged 28, all of whom were bitten while asleep in bed at night. Dr. Lewis states that gauze wet with saturated solution of magnesium sulphate kept on the bitten area "relieves the pain, reduces the swelling and prevents the progress of the disease." He also gave iodine, calomel and magnesium sulphate internally, but he does not state in what doses. The patients were able to resume work in from five to ten days.

ALBERT M. REESE
WEST VIRGINIA UNIVERSITY

SPECIAL ARTICLES

PREVALENCE AND DISTRIBUTION OF FUNGI INTERNAL OF SEED CORN

THE importance of root, stalk and ear rot fungi in decreasing yields of field corn has received considerable attention in recent years on the part of investigators. Results of investigations so far reported indicate more or less agreement in the various disease symptoms manifested. However, some difference of opinion exists concerning the importance of the causal organisms. The specific determination of the fungi has not been fully emphasized nor the method by which they are carried in the seed.

The following account presents in part the results of our investigations in determining the species of fungi associated with seed corn. Our studies were initiated to ascertain the losses and prevalence of infection in Delaware and the importance of the seed in carrying infection. While our observations and studies have been confined principally to the corn crop in this state we feel that careful investigations will reveal the presence and importance of the same pathogenes in other states but no doubt in varying degrees of prevalence.

Disinfection experiments followed by cultures soon indicated to us that certain parasitic fungi were carrying internal of the kernel and that a brief surface sterilizing with a strong disinfectant, followed by proper culture methods proved an efficient means of determining the amount of such internal infection.

We have found that an efficient test for determining the presence of fungi internal of seed corn and one which at the same time readily permits of the identification of the fungi, is carried out by disinfecting and planting the kernels or crushed kernels in sterile culture medium in Petri dishes. Fifteen or more kernels are disinfected in a test tube 150 $\times$ 20 mm. for one minute in a solution of 50 per cent. alcohol containing 1 gram of bichloride of mercury in each liter. Following this treatment the kernels are washed in the same tube with two successive washings with 20 c.c., each of sterile water and immediately ten kernels are removed aseptically with sterile forceps and placed with germ side down on 20 c.c., of nutrient glucose agar in a sterile culture dish. Further, five of the remaining kernels are each placed in a sterile culture dish and with a sterile scalpel the point of the kernel which is the portion that contains most of the internal infection is cut off one sixth to one fifth inch from the end; then with a strong sterile forceps each point is placed in the mouth of a heavy-walled tube (it requires a strong tube and strong forceps, as crushing is not easy) 150 $\times$ 20 mm. containing 10 c.c., of sterile nutrient glucose agar medium at 43° C.; the point is thoroughly crushed and shaken down into the medium, then well

mixed and poured into the sterile culture dish containing the remaining part of the kernel. (These methods were used extensively by the senior writer in his studies on fungi internal of flax, 1901–1904, and wheat, 1909.) In this manner a greater distribution of the mycelium or spores is possible and allows for accurate interpretation in instances where more than one fungus is being carried.

In most of the cultural plate work a dextrose peptone agar of the following composition was used:—tap water 1000 c.c., dextrose 10 grams, peptone 1 gram, agar 15 grams. Twenty cubic centimeters of medium were used in all cultural plates in which ten kernels of corn were placed for germination.

A careful study of the anatomy of seed which showed heavy infection after a sterilizing treatment, readily indicated how these parasitic fungi were escaping the disinfectant. In most cases where the internal pathogenes were not inhibiting germination, the fungi had gained entrance only to the cavity under the "cap"; or had penetrated but short distances under the pericarp. This was true of each of the fungi *Cephalosporium sacchari, Gibberella saubinetii, Fusarium moniliforme* and *Diplodia zeæ*. Whenever any of these pathogenes became established in the tissue comprizing the embryo the vitality was either destroyed or greatly inhibited. Observations thus far made indicate as a result of cultural and germinator tests that in order of importance of inhibiting germination *Diplodia zeæ* stands first, followed in order by *Gibberella saubinetii, Fusarium moniliforme* and *Cephalosporium sacchari.*

The samples submitted for this survey from states other than Delaware were not necessarily representative. The studies show at least the general occurrence of these fungi.

The establishment of *C. sacchari* as a para-

DISTRIBUTION AND PREVALENCE OF PARASITIC FUNGI INTERNAL OF SEED CORN

State	Number of Samples	Number of Kernels Cultured	*Cephalosporium sacchari*[1]	*Gibberella saubinetii*[1]	*Fusarium moniliforme*[1]	*Diplodia zeae*[1]	Germination[1]		
							Strong	Weak	Dead
Del.	219	3,285	39.54	5.95	19.92	5.69	86.35	9.56	4.09
Ark.	15	225	22.00	1.33	35.33	3.33	66.00	26.66	7.34
Conn.	12	180	16.66	25.83	41.66		84.16	14.16	1.68
Ill.	25	375	2.00		12.40	7.20	82.80	16.00	1.20
Ind.	17	255	4.70	4.70			96.44	3.56	
Ky.	34	510	3.82	4.11	17.94	4.85	59.70	15.59	24.71
Kan.	12	180	11.66		30.00		88.33	11.67	
La.	1	15			80.00		100.00		
Mass.	5	75		12.00	10.00	8.00	85.00	6.00	9.00
Md.	10	150	46.00	7.00	12.00	14.00	65.00	35.00	
Minn.	10	150	10.00	12.00	43.00		37.00	55.00	8.00
Miss.	16	240	38.13		40.00	3.12	74.37	25.00	.63
Neb.	14	215	22.85		20.00	1.42	85.71	4.28	10.01
N. C.	10	150	38.00	2.00	48.00		86.00	14.00	
N. Dak.	25	375			.40	.80	85.60	1.20	13.20
N. J.	10	150	24.00	21.00	17.00	2.00	79.00	21.00	
N. Y.	6	90		3.33			96.67	3.33	
Ohio	11	165	10.90	22.72	1.82	12.73	49.09	50.91	
Pa.	14	210	5.71	7.87			89.57	3.57	6.86
Tex.	7	105	14.28		71.42	2.85	21.42	78.58	
Wis.	7	105	20.00	2.85		10.85	97.14		2.86

[1] All data reported in terms of per cent.

site of corn is here reported for the first time to our knowledge in this country. This fungus was first described by Butler and Kahn (1913) as a parasite of sugar cane in India. A detailed report on these studies will appear in the February issue of the Journal of Agricultural Research.

T. F. Manns,
J. F. Adams
Agricultural Experiment Station,
University of Delaware,
May 10, 1921

GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY

The sixty-second general meeting of the American Chemical Society was called to order at Columbia University, New York City, on Wednesday morning, September 7, 1921, with President Edgar F. Smith presiding. The welcoming address was delivered by Dr. John E. Teeple, chairman of the New York Section, to which Dr. Smith responded in behalf of the Society.

The address of Hon. Francis P. Garvan on "Chemistry and the State" roused the audience to a high pitch of feeling regarding the present critical situation which chemistry in America is facing. The address of Sir William J. Pope on "Chemical Warfare" and of Professor R. F. Ruttan on "Organization of Industrial Research in Canada" were also received with enthusiasm. The addresses in full will appear in the October issue of the *Journal of Industrial and Engineering Chemistry.*

Dr. Smith read the following telegram of greeting from President Harding, which had been originally received as the visiting guests crossed the border into the United States at Niagara Falls on Monday, September 5, 1921:

It is a pleasure to extend greetings to the gathering of American, Canadian and British Societies representing the chemical sciences and industries meeting on American soil. Probably none of the materialistic sciences holds promise of so great contributions to human welfare in the coming generations as that which your organization represents. The developments of applied chemistry involve both a possibility of vastly increased horrors in human conflict and alternately inestimable benefits to a peaceful civilization. Let us hope that a science so fraught with either good or vicious possibilities may be turned, through the wisdom of the nations, to the benefit and advancement of mankind.

Warren G. Harding

The telegram was received with enthusiasm and the Society requested President Smith to express its appreciation in a suitable reply.

In accordance with the nominations of the council, Sir William Pope and M. Paul Kestner were elected honorary members of the society. Sir William responded in a delightful vein and expressed the extreme regret of M. Kestner at his inability to attend these meetings. Dr. Robert F. Ruttan, president-elect of the Society of Chemical Industry, and Dr. Ernst Cohen of the University of Utrecht were presented to the audience and heartily received.

The Committee appointed by the Council consisting of Messrs. H. T. Clarke, F. R. Eldred, and Chas. H. Herty submitted the following resolution, which was unanimously adopted:

Believing in the incalculable peace-time benefits which accrue from the development of the science of organic chemistry and its application in medicine, agriculture and the industries connected with foods, fuels, textiles and dyes.

Realizing the great rôle that organic chemistry has played in the development of chemical warfare, we call the attention of this nation to the grave crisis which threatens our organic chemical industry.

In spite of the tremendous strides made during the past five years in the United States, this important industry is still centered in Germany. Other nations have already sought to safeguard its future in their countries by appropriate legislation. America stands hesitant. Progress has been checked and indeed the very industry is threatened with destruction. Two agencies will be determinative in averting this disaster, the approaching International Conference on Disarmament and the Congress of the United States.

Resolved, therefore,

First, that we urge upon the American delegates to the Disarmament Conference most serious consideration of the broad question of chemical disarmament as affected by the development and maintenance of the chemical industries in the several nations.

Second, that we urge upon Congress the necessity of including in the permanent tariff bill a selective embargo for a limited period against importation of synthetic organic chemicals, and we express the confident hope that in view of the important bearing of such action on economical development and on national defense, our representatives regardless of political affiliations will support this legislation.

The fiftieth anniversary of Sir James and Lady Dewar's marriage having been recently celebrated, on August 8, it was moved that a congratulatory message be transmitted from the American Chemical Society.

On Tuesday evening a complimentary smoker, with nearly one thousand members present, was held at the Waldorf-Astoria, and an interesting program

consisting of music, vaudeville entertainment, cartoons, etc., was enjoyed by all.

At the International Meeting on Thursday afternoon, after an organ recital by Professor Samuel A. Baldwin in the grand hall of the College of the City of New York, which was greatly enjoyed by all, the following addresses were given:

Chemistry and Civilization: Dr. Edgar F. Smith, provost emeritus, University of Pennsylvania, in the chair.
Science and Civilization; The Rôle of Chemistry: Dr. Chas. Baskerville, director of the laboratories, College of the City of New York; chairman, International Committee.
Energy; Its Sources and Future Possibilities: Dr. Arthur D. Little, chemical engineer and technologist, Boston.
The Engineer; Human and Superior Direction of Power: Dr. Leo H. Baekeland, honorary professor of chemical engineering, Columbia University.
Chemistry and Life: Sir William J. Pope, professor of chemistry, Cambridge University.
Theories: Dr. Willis R. Whitney, head of research department, General Electric Company.
Research Applied to the World's Work: Dr. C. E. K. Mees, head of research department, Eastman Kodak Company.
Problem of Diffusion and Its Bearing on Civilization: Professor Ernst Cohen, professor of chemistry, University of Utrecht.
Catalysis: The New Economic Factor: Professor Wilder D. Bancroft, professor of physical chemistry, Cornell University.

On Thursday evening the banquet hall at the Waldorf-Astoria was crowded at one of the society's delightful gatherings, and on Friday night the members listened to the annual presidential address of Edgar F. Smith, entitled "Progress in Chemistry." This address was preceded by the unveiling of the Priestley portrait, which is to be placed in the National Museum, the unveiling being accompanied by a description of the life and work of Priestley, by Dr. C. A. Browne.

The following Divisions and Sections met: Divisions of Agricultural and Food Chemistry, Biological Chemistry, Chemistry of Medicinal Products, Dye Chemistry, Fertilizer Chemistry, Industrial and Engineering Chemistry, Leather Chemistry, Organic Chemistry, Physical and Inorganic Chemistry, Rubber Chemistry, Sugar Chemistry, Water, Sewage, and Sanitation Chemistry, and Sections of Cellulose Chemistry, Chemical Education and Petroleum Chemistry.

At the meeting of the Division of Biological Chemistry a Committee was appointed, consisting of A. D. Emmett, chairman, Alfred Hess, E. V. McCollum, L. B. Mendel, and H. C. Herman, to recommend methods for vitamine study.

Officers were elected as follows:

Division of Agricultural and Food Chemistry: *Chairman,* T. J. Bryan; *Secretary,* C. S. Brinton.

Division of Biological Chemistry: *Chairman,* H. B. Lewis; *Secretary,* J. S. Hughes; *Executive Committee,* R. D. Swain, R. A. Dutcher, H. C. Sherman, H. F. Zoller, A. D. Emmett.

Division of Chemistry of Medicinal Products: *Chairman,* E. B. Carter; *Secretary,* E. H. Volwiler; *Executive Committee,* A. D. Hirschfelder, Charles E. Caspari.

Division of Dye Chemistry: *Chairman,* W. J. Hale; *Vice-chairman,* L. A. Olney; *Secretary-Treasurer,* R. Norris Shreve; *Executive Committee,* B. A. Ludwig, R. E. Rose.

Division of Fertilizer Chemistry: *Chairman,* F. B. Carpenter; *Secretary,* H. C. Moore.

Division of Industrial and Engineering Chemistry: *Chairman,* W. K. Lewis; *Vice-chairman,* D. R. Sperry; *Secretary,* H. E. Howe; *Asst. Secretary,* E. M. Billings; *Executive Committee,* W. F. Hillebrand, Edward Mallinckrodt, Jr., F. M. DeBeers, Alexander Silverman, H. R. Moody, C. E. Coates.

Division of Leather Chemistry: Chairman, J. A. Wilson; *Vice-chairman,* J. S. Rogers; *Secretary,* A. W. Thomas; *Executive Committee,* Frank L. Seymour-Jones, R. McKee.

Division of Organic Chemistry: *Chairman,* H. T. Clarke; *Vice-chairman and Secretary,* F. C. Whitmore.

Division of Physical and Inorganic Chemistry: *Chairman,* S. E. Sheppard; *Secretary,* R. E. Wilson; *Executive Committee,* Wm. Blum, Joel Hillebrand, J. H. Mathews, L. C. Newell, H. B. Weiser, E. C. Bingham, G. S. Forbes.

Division of Rubber Chemistry: *Chairman,* C. W. Bedford; *Vice-chairman,* H. E. Simmons; *Secretary,* A. H. Smith; *Executive Committee,* W. B. Wiegand, W. W. Evans, J. B. Tuttle, D. F. Craner, F. G. Breyer.

Division of Sugar Chemistry: *Chairman,* S. J. Osborn; *Vice-chairman,* F. W. Zerban; *Secretary-Treasurer,* F. J. Bates; *Executive Committee,* C. A. Browne, C. E. Coates, W. D. Horne, W. B. Newkirk, H. S. Paine, H. E. Zitkowski.

Division of Water, Sewage and Sanitation: *Chairman,* A. M. Buswell; *Vice-chairman,* F. R. Georgia; *Secretary-Treasurer,* W. W. Skinner; *Executive Committee,* W. R. Copeland, W. D. Collins.

Charles L. Parsons,
Secretary

THE AMERICAN PHILOSOPHICAL SOCIETY

(*Concluded*)

Measurement of star diameters by the interferometer method: F. G. PEASE. Stephan, in 1874, following a suggestion of Fizeau's, made an attempt at measuring the angular diameter of the brighter stars by the interferometer method and rightly found that his telescope was too small. Michelson in 1890 devised a periscopic attachment, which, when placed upon the end of the telescope greatly increased its equivalent aperture; with it he measured the diameter of the satellites of Jupiter. A similar instrument upon the great 100-inch Hooker telescope on Mount Wilson enabled Michelson and Pease in 1920 to obtain a successful measure of the angular diameter of α Orionis.

A brief outline is given of the principles underlying the method of interferometer measurement, and of its application to use with the telescope. Pencils of light from the star passing through two small apertures in a screen covering the telescope, produce "interference fringes" which appear superposed on the regular diffraction image of the star. When the apertures are close together the "visibility" of the fringes is said to be 100 per cent. As the apertures are separated the visibility is reduced, the fringes become weaker and at a still further separation they vanish. The relation, $\alpha = 1.22\,\lambda/b$ existing between the angular diameter of a star, the effective wave length of its light and the distance apart of the two outer mirrors when the fringes vanish enables one to determine the star's angular diameter. The linear diameter of the star can then be calculated if its parallax is known. The interferometer attachment is described together with the method of operating it. It consists of a fabricated steel beam 21 feet long, carrying four 6-inch mirrors, inclined at 45°, the two inner ones being fixed and faced downwards, the two outer adjustable and facing upwards. It is placed on the end of the telescope and observations made at the Cassegrain focus, which has an equivalent focal length of 134 feet. An auxiliary optical device, consisting of a movable wedge of glass and a plane parallel compensator enables the observer to equalize the two pencils of light and obtain the desired fringes. Two additional pencils passing over the ordinary path in the telescope, form a comparison image with "zero" fringes superposed; both interferometer and comparison images are viewed simultaneously with an eyepiece. When the seeing is poor it is difficult to be certain that the fringes have actually vanished; a weakening of the zero fringes, however, at the same time furnishes the observer with a check in the matter.

On December 13, 1920, the interferometer fringes vanished for α Orionis when the distance between the mirrors was about ten feet. The seeing was good and the instrument adjustments were verified on check stars both before and after the observation. Assuming a wave-length of 5.75×10^{-5} cm. the approximate angular diameter is $0''.047$. Using a value of $0''.020$ for the parallax, the linear diameter is roughly 218,000,000 miles.

Definite decrease in visibility of the fringes has been observed by the writer with the 20 foot interferometer, for α Tauri, α Bootis, α Scorpii and β Geminorum. The diameter of β Geminorum is smaller than can be measured with this interferometer. Additional observations will be necessary to definitely determine the diameter of the others. The work will be continued until all the brighter stars have been examined.

Atomic theory and ideal numbers: LEONARD EUGENE DICKSON. On the basis of close analogies with the molecular and atomic theories, it is possible to give a clear insight into the nature of ideal numbers, which play such an important rôle in the mathematical world to-day. This special importance is due to the fact that only after the introduction of ideal numbers do the laws of divisibility, valid in arithmetic, hold also for algebraic numbers. Without ideal numbers the situation in regard to algebraic numbers is most chaotic. The restoration of order out of chaos by the invention of ideal numbers is one of the chief mathematical triumphs of our century.

A general catalog of stellar distances: FRANK SCHLESINGER. This paper deals with a review of the various methods for determining stellar distances and describes the methods that have been employed to mold the observations into a homogeneous whole.

Intermittent vision at low intensities: HERBERT E. IVES. An experimental study of the phenomena of flicker at low intensities where twilight or rod vision prevails. Blue light was used, reduced in intensity until all sensation of color disappeared. Under these conditions the speed of alternation of light and dark at which flicker disappears, becomes independent of changes of intensity, unlike its behavior at high intensities where it increases or decreases as the intensity is raised or lowered. The

principal object of the study was to find the effect on flicker of various "wave-forms" of light distribution throughout the intermittent cycle. Rotating discs were used, cut to various simple shapes and openings, and rotated in such relation to a light source that the illumination of the observing target could be interrupted gradually, abruptly, partially, or for varied fractions of the total cycle or period of intermittence. The speeds were found at which the sensation of flicker disappeared ("critical speeds"). These vary in a systematic manner with the change of wave-form, but in a different manner from their course at high intensities. A strikingly simple mathematical expression has been found to represent the critical speed-wave-form data. If the wave-form is represented by its expansion in a Fourier series, the critical speed is directly proportional to the logarithm of the coefficient of the first periodic term of the expansion, divided by the average value.

The effect of tension on the electrical resistance of some of the more unusual metals: P. W. Bridgman. In this investigation those metals have been examined which are abnormal in that their electrical resistance increases under hydrostatic pressure. It is normal for the resistance of a metal to increase under tension. The point at issue was whether the metals which are abnormal in their pressure coefficients would also be abnormal in their tension coefficients. Five metals are known whose pressure coefficients of resistance are abnormal; these are bismuth, antimony, lithium, calcium, and strontium. It was found in this investigation that the tension coefficients of only two of these, namely bismuth and strontium, are abnormal, whereas that of the other three are normal in that the resistance increases under tension. Taken in conjunction with the view of the nature of metallic resistance which I have developed recently elsewhere, these facts are taken to indicate that the mechanism of conduction in lithium is by a passage of electrons between the atoms, whereas in bismuth the conduction is mainly by the passage of electrons through the atoms. In strontium it is probable that both types of conduction are present, in calcium that the conduction is mainly of the first type, and in antimony mainly of the second. The alloys manganin and "therlo," whose pressure coefficients are abnormal, have also been investigated, and their tension coefficients found to be normal. This is also in accord with the theory.

The conductivity of mixtures of nitrogen and chlorine in a flaming arc: W. A. Noyes. For about seven years the author of the paper and his assistants have attempted to secure the direct combination of nitrogen and chlorine by methods similar to those which are used in the preparation of the oxides of nitrogen by the use of the electric discharge. Some of the early experiments seem to indicate that nitrogen and chlorine combine in the electric arc, but after a very careful elimination of every trace of oxygen and of moisture from the apparatus no combination could be established. Less than 0.3 of a milligram of combined nitrogen was found in an experiment which was conducted for 51 hours. When air was subjected to the same conditions several grams of the combined nitrogen were obtained.

Rose Atoll, Samoa, in its relation to recent change in sea level: Alfred G. Mayor. This rarely visited atoll proves to be composed of lithothamnion rather than coral. The atoll rim was once about 8 feet higher than at present, and has been cut down nearly to present sea level after the ocean subsided to this extent in recent times. The extreme isolation of the atoll is shown by the fact that there are only three species of plants upon the island; a *Pisonia* forming a beautiful grove of trees, a small yellow-flowered *Portulaca*, and a creeping pink-flowered *Boerhaavea*. A rat allied to a Malayan form, and widely distributed over Polynesia is the only mammal on the island. It is interesting to see that all the islands of American Samoa indicate that the sea was once at least 8 feet higher than at present, and Rose Atoll leads us to infer that the climate was tropical when the sea level was highest, for fossil corals and lithothamnion are found in the atoll rim above present sea level.

"Turtle Oreodon Layer" or "Red Layer," a contribution to the stratigraphy of the White River oligocene (results of the Princeton University 1920 expedition to South Dakota: W. J. Sinclair. This paper describes the lowest member of the Oreodon beds in the Big Badlands of South Dakota, a pinkish gray clay with several zones of rusty nodules at its top. Although it has supplied abundant fossil bones to collectors for over seventy years, very little has been published about it, and the present paper endeavors to give some details regarding its nature, the origin of the sediments, conditions under which they were laid down and so on, and to tie up certain of the changes both in sediments and faunas to a climatic factor. The first fresh-water algal limestones to be identified in any of our continental tertiary formations are described.

SCIENCE

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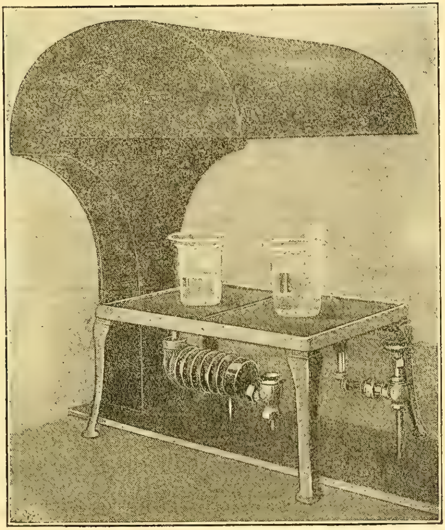

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SCIENCE

Friday, October 28, 1921.

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

RESEARCH IN EUGENICS[1]

Man is studying all phenomena. He has at last come to study himself. Not his diseases, not his language, not his customs merely, but also his more intimate self. Man is studying man as an animal, who varies in his traits, who selects his mates for better or worse, who has a larger or smaller number of children that are more or less healthy and live for a varying period. The races of man are being studied not merely to list their differences, but to find how those differences arose and how they are transmitted to progeny and how they intermingle. We are studying the laws that govern the distribution of traits in the family; we are studying the consequences of combinations of these traits in the instincts, interests and behavior of individuals. At last we are studying man as the product of breeding and as the subject of an evolutionary process. And we are studying the human germ plasm, its composition, its mutations and its mixtures.

And why do we investigate? Is not enough known to warrant *propaganda;* and should we not better organize for a campaign to change what needs changing? Alas! we have now too little precise knowledge in any field of eugenics. We can command respect for our eugenic conclusions only as our findings are based on rigid proof, a proof that is either statistical or experimental. Only as we are able to base our statements on scientific, quantitative data can we hope to carry conviction and not arouse contrary opinion. People do not have heated discussions on the multiplication table; they will not dispute quantitative findings in any science.

It is largely due to the extraordinary vision of Mrs. E. H. Harriman, the founder of the Eugenics Record Office, that in this country eugenics is more a subject of research than of

[1] Address at the opening session of the International Congress of Eugenics.

propaganda. She maintained that we should be more concerned with knowing than with doing. Ascertained facts do not require propaganda.

It is sometimes asserted that research in eugenics belongs to the realm of applied science, and much of it does. But not all. There are fields of eugenical research, especially in human genetics, that are pure research in as much as they are devoted to investigations that can not be carried out so well on any other material. For example, inheritance of psychological traits, of temperament and of sense perception.

In so far as eugenics may lay claim to being a science, it has not only a subject matter—but also a method of its own. In studying the genetics of the lower animals, we proceed by the method of control of matings. Now this method is obviously not applicable to man in modern civilized countries. It has to be replaced by the collection of the history of matings that have been already made and a study of their progeny. We replace the experimental mating of the geneticist with the principle that every fertile human mating is an experiment in genetics, and it is for us to record the result of the experiment. Some day, we may hope, human matings will be carried beyond the stage of experiment.

At present, then, the student of human genetics must collect data on human matings and their outcome. Of course, he must know, as thoroughly as he can, the genetic nature of the matings; so that he can give the probable genetic composition of the gametes. This means that he must know for the mated pair, the parents, uncles and aunts and their children. He can then check his findings by studying the traits of the children. Since the capacity of one man for collecting by himself is very limited, it is necessary to train observers to collect data. Hence has arisen the profession of eugenical field worker whose function it is to study through three or more generations and as analytically as possible all the members of an inter-generating group so that their probable genetic composition may be known. By gathering together in one depository a large quantity of carefully ascertained family data, the basis is laid for human genetical studies.

The history of the development of the method of eugenical field workers is not a long one. Dr. Alexander Graham Bell was one of the first to use it extensively in this country. He employed such field workers in his study of deaf mutes especially those of Martha's Vineyard, in the early eighties. The Reverend Oscar McCulloch made use of field workers in his study of the Ishmaelites in the nineties, and at the Vineland Training School such workers were employed before 1910. A large number of eugenical field workers (about 200) have been trained by the Eugenics Record Office since its beginning in 1910.

Besides trained field workers, numerous volunteers are in a position to contribute data. Thus, in 1884, Francis Galton distributed his questionnaires called "Record of Family Faculties," and over 150 persons volunteered to fill them out and return them to him for study. The Eugenics Record Office has made use of a similar questionnaire called "Record of Family Traits," of which 4,000, of varying degrees of excellence, have been deposited in that office. Some of these "Records" are exceptionally valuable. It appears that many persons show the capacity for and interest in filling out such schedules excellently. A few others will take the pains to make a still more detailed analysis of the individuals of their families. Many of these records have to be considered as *finders* merely; as guides to further inquiries.

Additional records that are often of value are the printed genealogies and town histories, of which so many have been printed in this country, especially for the northeastern section. In addition, biographies, especially sets of biographies relating to members of a single family, will yield to the analyst of human traits data of the greatest importance. Finally all records—those of field workers, of volunteers and the printed records—must be indexed by name, place and trait so that their contents shall be readily available.

In inquiries into human genetics it is de-

sirable, where possible, to breed experimentally mammals, if any are available, which show the same trait that we are studying in humans. This is often possible, and such study will afford a control of results gained on man. Thus have been studied hare-lip in dogs, fecundity in sheep, instincts in dogs, polydactylism in fowls.

In other studies the method employed will be that of accumulation of statistics, their tabulation and analysis. Thus we investigate mate selection, the relative fecundity and relative mortality of the various stocks and the effect on the germ plasm of a country of the different immigrant races.

Some of the results of analytical study of these eugenical data are fairly well established. A few clearly simple Mendelian traits have been found. Such is eye color in which brown is dominant over its absence. It is possible that in some cases additional factors may be present, but the rule serves as a first approximation. Dominant, also, appears to be curliness of the hair as contrasted with recessive straight. And there are various diseases and defects that appear either as simple dominants or recessives, such as abnormalities in number and form of fingers and toes, which are mostly dominant over the normal condition; various defects of the eye such as cataract, certain types of congenital deafness, various abnormalities of skin, and hair and nails.

Other, and probably many other, traits are due to multiple factors—so often this is true as to suggest the hypothesis that in mammals, as contrasted with insects, traits are genetically relatively complex. Thus stature and build and proportions of parts and pigmentation of hair and skin are dependent on multiple factors. Indeed, there seems to be evidence that negro skin color is dependent upon two pairs of factors which merely reinforce each other.

Other traits are associated with sex in the remarkable fashion called sex-linked. That is, they are usually found only in the male sex and are inherited through the mother, though she, herself, is not affected. In such cases one usually finds male relatives of the mother who are affected. Such are color blindness, hemophilia and atrophy of the optic nerve. The facts of sex-linked heredity bring home, even to the layman, the lesson that heredity is a matter of the gametes; and that bodily appearance often gives no hint of the nature of the particular germ-cells carried and, in so far, of what the inheritance shall be. The parents of an albino may have pigmented hair and skin, but both carry gametes which lack the capacity of forming pigment.

Our knowledge of the inheritance of these physical traits is sufficiently precise to be applied practically in cases of doubtful parentage. If the child, the known mother and both of the putative fathers can be seen, and some inquiry be made as to family stock of the three adults a decision can generally be rendered with a high degree of certainty ranging from 75 to 99 per cent. For usually there will not be one critical trait merely but several traits whose combined evidence will be overwhelming. Already the Eugenics Record Office has been asked to answer certain questions about the inheritance of traits in a case of a claimant who maintained that he was the son of a wealthy man who died without known heirs. As lawyers get more used to the idea of utilizing the advances of knowledge for evidence, it is probable that eugenical knowledge will be more and more called upon.

Not only of the physical traits referred to above but also of those of behavior we are learning the hereditary basis. It appears probable, from extensive pedigrees that have been analyzed, that feeble-mindness of the middle and higher grades is inherited as a simple recessive, or approximately so. It follows that two parents who are feeble-minded shall have only feeble-minded children and this is what is empirically found. It has been urged against this finding that it is improbable that so complicated a thing as full mentality depends upon only one factor. On the other hand, a consideration of the effect of internal secretions, of thyroid, of hypophysis and others leads to the conclusion that a brain with well differentiated intellectual centers may fail of complete development because of the absence of proper developmental impulses of glandular origin.

Two persons whose brains are thus under developed may differ greatly in their mental capacities, because they have fundamental nervous differences, just as seedlings of different species, while all alike under-developed, differ in certain specific traits. Apparently one group of hereditary mental defectives is such because those who belong to it lack a single factor for an adequate developmental impulse.

Epilepsy, of the ordinary juvenile, dementing type, seems to be due, like feeble-mindedness, to a single developmental defect. Also, dementia præcox has been found by several investigators to be due to a similar cause.

But not only mental but also emotional states have a hereditary basis. The prevailing depressed mood appears to be due to a glandular condition that is determined by a certain developmental defect; and a prevailing excitability appears to be determined by a hereditary condition, which may be a tendency to excessive secretion of the suprarenal glands.

Moreover, the quality of our senses has a clear hereditary basis, as the still unpublished work of Dr. Hazel Stanton on musical families clearly shows. It appears from these studies that not only have great musicians an innate capacity for discriminating between closely similar qualities of pitch, intensity, time and for tonal memory but they belong to families with these innate capacities. Also, it has been shown that these capacities are not improvable by training; they depend upon our very constitution. Now we have evidence that persons who have these capacities enjoy exercising them. Those in whom the capacities are slightly developed get no pleasure from exercising them. We conclude that the reason why musical people are such is primarily because of their possession of inborn musical capacities. The musician is born, not made. From these principles certain deductions seem naturally to flow. A great color artist is one in whom the innate capacity for color discrimination is well developed and his family shows other examples of colorists. The sculptor has the hereditary capacity for form discrimination and that is why he finds his highest pleasure in the art. The author is one whose verbal machinery is especially perfect. The sailor is one who finds his greatest pleasure in the beauty of form of the vessel, or perhaps in broad horizons and distant lands; he is neither claustrophil, nor domestic. In general, our vocations, or at least our avocations, are determined by our sensory structure and this is hereditary.

The fact that not only our physical but also our mental and temperamental characteristics have a hereditary basis has certain important social bearings. It leads us to regard more charitably the limitations of our fellow men. The false doctrines of human equality at birth and of freedom of the will have determined a line of practise in the fields of education and criminology that, it seems to me, is not productive of the best results. In education we must know the child's native capacities before we can properly train. In dealing with delinquents we must know the hereditary, mental and emotional make-up before we can get an explanation of the bad conduct and before we can intelligently treat the delinquent. Organized society is too prone to "pass the buck" of its own shortcomings to the hypothetical "bad-will" of the offender against the mores. We should do better if we treated the misdemeanant as we treat a puppy whose actions displease us. Either train him carefully, if he is trainable; otherwise, put him in a position where the exercise of his instincts will not offend us.

The relation of the glands of internal secretion, commonly known as endocrine glands, to human development and human behavior is becoming daily more obvious. Stature, build, proportions; details of development of bone, teeth, nails, hair, skin; intelligence, emotional control, all these things can be shown to be influenced by endocrine secretions. Indeed, it seems naturally to follow that the hereditary differences between people are due to hereditary differences in the activity of these glands. Now these glands, as is well known, secrete substances called "hormones" which regulate our physical, mental and temperamental constitution. The special quality and quantity

of these hormones is determined by the idiosyncrasies of the enzymes of the germ cells. The hormones that determine our personality, constitute the bridge that connects this *personality* on the one hand, with the *specific enzymes* packed away in the chromosomes of the germ cells, on the other. You and I differ by virtue of the difference of atomic structure and atomic activity of the enzymes and hormones which make up that part of the stream of life-yeast which has got into and is activating our protoplasm and will activate that of the fertilized egg that results from us and our consorts. Thus each is what he is in his physique, in his thoughts and in his reactions largely by virtue of the peculiar properties of those extraordinary activating substances, which are specific for him and other members of his family and race or biotype. The future of human genetics lies largely in a study of these activities, and the origin of differences or mutations in them.

The study of human genetics leads into numerous fields of the physiology of human reproduction. Of these one of the most significant is that of twin-production. This topic has many aspects. As is well known twins are of two types. Two-egg twins come from two eggs simultaneously ovulated and one-egg twins arise by a division into two embryos of a single young embryo. The two children which thus arise from one egg are often so marvellously similar that they are called "identical twins." Now these identical twins give a measure of the relative importance of heredity and environment, as Francis Galton pointed out. It is, indeed, marvellous to see how such twins, even though living far apart, retain their initial resemblancy, experience at almost exactly the same time similar disease and emotional disturbances. Even the thoughts, as measured by the so-called "association" tests and the finger prints are marvellously similar. The dissimilarity of environment has had little effect on altering the rhythm of development, which is controlled by an internal mechanism. The two-egg twins are merely ordinary brothers and sisters who are born simultaneously and though the intrauterine environment and that of early years is as nearly identical as possible, yet they are as dissimilar as brothers and sisters are apt to be.

Though human heredity is the leading branch of eugenical research, yet it is only one. A fascinating branch of the subject is that of mate selection, including a study of those external and internal conditions that control in this phenomenon. While propinquity is often considered the all-sufficient basis of mate selection, yet statistical research reveals such facts as these; that there is a selection of mates of corresponding divergence from the mean in stature; that red-haired persons do not marry as frequently as expected on a random basis; that persons of opposite temperaments tend to marry with each other.

Research on fecundity, especially the differing fecundity of peoples having dissimilar social values in the population has not received the attention it deserves; still we know something of the fractions of sons and daughters of college men and women and have some facts available towards a study of fecundity of the socially inadequate. Always, however, it is not to be forgotten that it is the residuum of surviving children of a marriage that counts in the race and the children of the less socially adequate strains are permitted a larger selective death rate than are those of the more efficient strains. That is one reason why from the less developed strains, vigorous and effective progeny are occasionally arising; while some lines of the more effective and prosperous families end in weak and lethal descendants. Modern surgery has done much to keep alive weak and defective individuals, but little to improve racial qualities. Selection and its effects, including those of war, have been all too little studied.

But fecundity of stocks is only a part of the problem in a country which, like ours, has in a single year, added about as much to the population by immigration as by birth. Probably never before in the world has such a migration of all sorts of races in such numbers, over so great a distance, taken place. Here in America we have watched the process

with misgivings, and felt a lack of sufficient knowledge to direct our action. The present policy of *selecting* immigrants is a reasonable one, certainly; and every one who recognizes the effect of quality of the germ-plasm on national life, hopes it will be continued and extended until we know something of the family, as well as individual performance, of each applicant for entry into the United States. The best, as well as the most recent study of the effect of a mixture of races upon a country is Mr. Charles W. Gould's "America: A Family Matter," and his conclusions are not encouraging. But the student of human genetics hopes to put this marvellous mixture of races to account in his study of human inheritance. The greatest opportunity in the world is offered for the study, since nearly all the races of mankind can be found in New York City alone, in considerable numbers, talking the one language and making mixed marriages, which are often strikingly diverse. This is a field that is extremely alluring and which has been little worked.

But I fear I tire you with this prolonged discussion of the results and the future of eugenical research. No doubt there are many who are inquiring "But where does environment come in?" And there are others who would urge that the great problem for investigation is that of the relative importance of heredity and environment. It seems to me that we should not formulate the problem in this manner. There is no heredity without environment and few environmental effects which are not dependent also upon heredity. Schooling is good for those who are not feeble-minded; moral training yields excellent results in the case of such as have normal inhibitions; musical education is valuable if the elements of musical capacity are present; painting lessons are fine if the pupil be not color blind. Certainly every child deserves the greatest possible opportunities; but the same conditions will be an opportunity to him who is able to take advantage of them, and no opportunity to him whose hereditary limitations do not enable him to use them.

And finally, what are some of the practical applications that we may expect to be made of eugenical research? One, certainly, is a higher estimation of the importance of hereditary capacities in human behavior. This may save us from disregard of innate differences—capacities which lead us on the one hand to adjudge all men equally capable of acting in accordance with the *mores;* and, on the other, to explain all offences as due to poor environment. Both false views neglect the fact of differences in inborn capacities.

Again, there will come a realization of the importance of heredity in marriage matings. Young persons to whom marriage is so serious a matter, will be led to stop and consider, when they feel they are falling in love, and inquire concerning consequences to offspring. Already there is being developed a well-defined conscience in the matters of cousin marriages, and of matings into families with grossly defective members. This is shown by the extensive correspondence that the Eugenics Record Office has been obliged to enter into with persons who are contemplating marriage. They are quite willing to submit an extensive account of their family traits; and they write to learn what is known about the inheritance of some family weakness or defect. The people who make these inquiries are often unusually intelligent and not at all radical; some of them stand high in the social world. It is a high idealism and a forward looking one which leads them to seek the desired knowledge and one can only respond to these requests, telling what is known, or highly probable, in respect to the recurrence of the family defects in the offspring. Whether the conclusions that one is able to give are always very valuable or not, at least the custom of considering children and their inheritance of familial traits is one to be encouraged. Normal persons marry to beget normal children and it is natural for them to seek information concerning heredity of particular traits.

And again, it may be hoped that the study of racial characters will lead men to a broader vision of the human race and the fact that its fate is controllable. We may hope that reason-

able persons will consider the progress of mankind, not by the years of generations merely, but by centuries or millenia. We may learn by the history of mankind in the last 20,000 years how near it has come to extinction; and we must recognize that it will take only a little interference with natural instincts and a little interference with natural selection during a few generations to bring the species, or one race of it, rather abruptly to an end, just as other human races have come to an end in historical times. The human species must eventually go the way of all species of which we have a paleontological record; already there are clear signs of a wide-spread deterioration in this most complex and unstable of all animal types. A failure to be influenced by the findings of the students of eugenics or a continuance in our present fatuous belief in the potency of money to cure racial evils will hasten the end. But if there be a serious support of research in eugenics and a willingness to be guided by clearly established facts in this field, the end of our species may long be postponed and the race may be brought to higher levels of racial health, happiness and effectiveness.

Charles B. Davenport

JOEL ASAPH ALLEN

Through the death, on August 29, 1921, of Dr. Joel Asaph Allen, science has lost a pioneer and a most devoted servant. A memorable career, filled with achievement and marked by years of unflagging application and energy, has been closed in its eighty-fourth year.

Joel Asaph Allen was born in Springfield, Massachusetts, July 19, 1838, of New England parentage. Through his father, Joel Allen, he traced his descent back to an Allen who came to the Colonies about 1630, while the maternal line of descent was from John Trumbull who settled in Massachusetts in 1639. The eldest of five children, his early life was spent on the paternal farm in an atmosphere of puritanical strictness. His schooling began with attendance at the rural school, generally in the winter only, because of the demands of the farm for the summer months. The boy very early displayed an intense love of nature and a keen interest in all its manifestations. While this did not meet with the wishes of his father there was no active or unkind opposition, and from his mother he met only sympathy.

Dependent at first solely upon his own efforts, without the aid of books or the acquaintance of naturalists, the boy showed a great determination to interpret the life about him. Later, when his attendance at Wilbraham Academy led up to Cambridge and the opportunity of studying under Louis Agassiz, he was prepared to make the most of every opportunity. However, this zeal for the constant study of nature, in addition to the work necessary in helping on the farm, resulted in the overtaxing of his strength and the impairment of his health, a condition which gave him much trouble throughout his lifetime and finally put an end to all field work.

His association with Agassiz began when he entered Cambridge as a special student and lasted until the latter's death. Among his associates in these classes conducted by the great teacher, were men destined to become famous, authorities in their special fields. The names of Alpheus Hyatt, E. S. Morse, A. S. Packard and A. E. Verrill are to be found on the rosters of those days at Cambridge.

The story of his schooling at Wilbraham Academy and later at Cambridge is that of a young man anxious for knowledge, but especially eager for the subjects bearing upon the natural sciences. With an ardent desire to do editorial work, young Allen found difficulty in composition and set himself to acquire this facility by keeping a daily journal, among other items making note of current weather conditions. When a summary of these weather reports were handed in as a composition at the academy, the boy was delighted to discover that Professor Marcy, his instructor, thought them worth publication. The summary came out in the *New England Farmer* and was the first of a long series from

the young naturalist, then about eighteen or nineteen years of age. Thus was begun the literary career that has produced such bountiful results and the youth who forced himself to acquire facility in a daily journal developed into the editor of not one, but several, of the foremost publications of natural science.

At the Lawrence Scientific School, at Cambridge, Allen was the pupil of men whose names stood high—Louis Agassiz, Asa Gray, Lovering and Wyman. At this school his curriculum was heavily inclined toward the natural sciences and he learned the value of accurate and painstaking observation. Because of poor health and weak eyes, the student was compelled to take instruction irregularly and to suffer many obstacles in his struggle for education.

In 1865, Agassiz invited Allen to accompany him on a collecting trip to Brazil. The party numbered sixteen and all during the voyage south Professor Agassiz gave a series of lectures to the members of his party. They landed at Rio de Janeiro and different trips were planned. Allen was assigned to a party which was to visit the northern provinces. They set out on June 9, and after delays and difficulties with their native assistants reached Lagoa Santa on July 13. This is the locality made famous by the researches of Lund and the scientists explored the caves of the region for several days. The route necessitated long hard travel, partly by river, partly by pack train. Allen's health had broken down by the end of the third month of this trying life, and he was forced to leave the others and strike out for Bahia, which he reached by the end of November, after an overland journey of nearly 600 miles. His voyage northward was not soon to be forgotten, because his ship which ran into gales off Cape Hatteras, was driven off her course and only narrowly escaped foundering. Approaching the Cape a second time, she was again met with storms and eventually reached Boston ninety days out from Bahia.

In the attempt to build up his constitution, Allen severed connections with the Museum of Comparative Zoology and returned to the farm, but, with the partial return of strength, found the call of nature to be irresistible and made a collecting trip into the Middle West, 1867. This trip was successful in every way and when a summer had been spent out of doors and Allen felt equal to museum work once more, he wrote to Agassiz, who welcomed him back. The next eighteen years were spent at Cambridge, where he was in charge of the department of mammals and birds.

The winter of 1868–1869 was spent in East Florida where valuable material and experience was gained. Nine months were spent on a collecting trip to the Great Plains and the Rocky Mountains, in 1871–1872. Work was begun at Leavenworth. At this time there was trouble with the Indians and the small party had to exercise caution in their movements. Near Fort Hays they went on a buffalo hunt, and Allen had his first extensive experience with the mammal which was to be one of his favorites and the subject of a large monograph. Their itinerary took them through Denver and South Park, Cheyenne, Green River and Fort Fred Steele. The results of the expedition were most satisfactory and a large number of specimens were secured.

The next year, 1873, Allen made his last important field trip. He accompanied a party of railroad surveyors who were to locate the Northern Pacific Railroad westward from Bismark. It was during a period of Indian troubles, and a large military escort under General Custer went with the party. This was a historic trip, marked by skirmishes with the Indians, and by many other novel experiences. While opportunities for collecting specimens were not of the best, much of the territory traversed was zoologically unknown and much valuable information was brought back.

From 1876 to 1882, Dr. Allen served as a special collaborator of the United States Geological Survey, devoting most of his time to original research, publishing among other papers, "The American Bisons, Living and Extinct," and monographs of various families

of the North American Rodentia, the latter in cooperation with Dr. Elliot Coues. At this time his interest was drawn to marine mammals and after he published a "History of North American Pinnipeds" he took up the Cetaceans, but illness checked the work before it was finished and the results never were printed. A short trip to Colorado was taken, upon the advice of a physician, in the attempt to throw off this illness, but a nervous breakdown resulted and it was months before active work could be resumed.

In 1885, the financial resources of the Museum of Comparative Zoology were so restricted as to cut down opportunities for the staff, and Dr. Allen accepted a curatorship in the American Museum of Natural History in New York City. He took over his duties on May 1, 1885, and served thirty-six years in that capacity, as curator of the department of ornithology and mammalogy. Later this department was divided into the department of mammalogy and the department of ornithology, Dr. Allen retaining the curatorship of the former department. In 1921, he was made honorary curator in order to give him entire freedom for research work.

At the time he took over the department, the collections were very small with no research facilities, and no study collection to serve as the basis for original work. During his tenure, the department entered upon a period of growth and expansion of marvelous proportions. At first he was alone, without any assistants, but in 1888, he was given his first assistant, Mr. Frank M. Chapman, and later others joined the department until at the time of his death, the scientific staff of the two departments which were formerly his department, numbered ten, besides non-staff assistants and field collectors. Collections were brought in, first from the United States, Mexico and British Columbia; and then the scope of activities was enlarged to take in South America, Africa and the Orient. In 1921, his department had parties in the field and plans for work in Asia, Africa, Australia, North America, South America and the West Indies.

Coincident with the vast accumulation of research collections, which grew from practically nil, in 1885 when the new curator took charge, to a total of about 50,000 specimens of mammals in 1921, there has been a corresponding increase in the number of mammal groups placed upon exhibition in his department. There has been a transition from the hall filled with a heterogeneous assemblage of mounted individuals to halls given over to carefully planned habitat groups which tell a story. Publications from the department of mammals may be said to begin with Dr. Allen's curatorship and the total number of scientific papers written by him in this capacity is a surprisingly large number.

While Dr. Allen devoted his later years almost exclusively to research in mammalogy, the sum total of his endeavors discloses work in many other branches of natural science. The bibliography, published in the volume also containing the autobiography[1], contains the following large numbers of titles: papers on mammals, 271; on birds, 966; on reptiles, 5; on zoogeography, 9; on evolution, 22; on nomenclature, 35; on biography, 134; miscellaneous, 20; a grand total of 1,433 titles published up to 1916. Since 1916 many other papers have appeared and a great deal of manuscript has been prepared which has not been published. When it is considered that each one of these publications is a well thought out piece of work, in most cases necessitating days spent in the study of material, and that many of them are papers of length, such as his monographs on the bison, the seals or the musk ox, which contain several hundred pages of text, then one is forced to marvel at the amount of mental labor involved and the tireless energy that drove the man.

His youthful yearnings for editorial work were realized to the full. Beginning with the year 1874, when he edited a volume of the *Proceedings* of the Boston Society of Natural

[1] "Autobiographical Notes and a Bibliography of the Scientific Publications of Joel Asaph Allen." American Museum of Natural History in 1916.

History, he served continuously as the editor of one or more scientific publications until 1918, when he was forced to give up editorial work because his advancing age demanded that he restrict his activities. For forty-four years he acted in editorial capacities and some of these publications ranked with the foremost in natural science. From 1884–1911, he was editor of the *Auk, A Quarterly Journal of Ornithology,* the publication of the American Ornithologists Union, during which time twenty-eight volumes appeared. As a testimonial to the esteem in which his tenure was held by his fellow ornithologists, Witmer Stone, the succeeding editor of *The Auk,* wrote:

> Beginning with the initial volume of the Bulletin of the Nuttall Ornithological Club, and continuing to the present year, Dr. Allen has, without intermission, guided the course of this journal and its successor The Auk; and the series of thirty-six volumes stands as a perpetual monument to his ability, and his painstaking devotion to the cause of ornithology and the interests of the American Ornithologists' Union. There have been few continuous editorships of equal length in the history of scientific periodicals.

An even longer editorial service was rendered to the *Bulletin* of the American Museum of Natural History, for beginning with the first volume, 1886, he directed the ever lengthening series until 1918, a total of thirty-two years. From the standpoint merely of routine accomplishment, this would stand as an editorial achievement to be envied, but with Dr. Allen, editorial duty meant more than that and each contribution was read as painstakingly and given the same attention as he gave to his own personal contributions.

Nor was he content to rest his editorial laurels upon these two terms of service but edited the zoological numbers of the *Memoirs* of the American Museum of Natural History from 1893 to 1918, and was the editor, or a joint editor, of the two editions of the "Check-List of North American Birds," 1895 and 1910, "Supplement to the Code of Nomenclature and Check-List of North American Birds," 1889, and "The Code of Nomenclature" adopted in the American Ornithologists Union, 1908.

Among his first papers are many of a philosophical nature, such as articles on the geographical variation in mammals and birds, the geographical distribution of mammals and the laws that govern the distribution of animal life, the genesis of species, the instinct of migration, etc. It is quite likely that his inclination in this direction would have led to many other papers along similar lines, but when material from the field began to come into his department at the American Museum, it became necessary for him to devote his entire time to the building up of the department and the identification of species.

His philosophical papers show the result of close observation and keen analysis and some of his deductions are recognized today as natural laws. In 1876, in his "Geographical Variation among North American Mammals" he set forth the following:

> In a general way, the correlation of size with geographical distribution may be formulated in the following propositions:
>
> 1. *The maximum physical development of the individual is attained where the conditions of environment are most favorable to the life of the species.* Species being primarily limited in their distribution by climatic conditions, their representatives living at or near either of their respective latitudinal boundaries are more or less unfavorably affected by the influences that finally limit the range of the species. . . .
>
> 2. *The largest species of a group (genus, subfamily, or family, as the case may be) are found where the group to which they severally belong reaches its highest development, or where it has what may be termed its center of distribution.* In other words, species of a given group attain their maximum size where the conditions of existence for the group in question are the most favorable, just as the largest representatives of a species are found where the conditions are most favorable for the existence of the species.
>
> 3. *The most "typical" or most generalized representatives of a group are found also near its center of distribution, outlying forms being generally more or less "aberrant" or specialized.* Thus the Cervide, though nearly cosmopolitan in their distribution, attain their greatest development, both

as respects the size, and the number of species, in the temperate portions of the northern hemisphere. The tropical species of this group are the smallest of its representatives. Those of the temperate and cold temperate regions are the largest, where, too, the species are the most numerous. . . . The possession of large, branching, deciduous antlers forms one of the marked features of the family. These appendages attain their greatest development in the northern species, the tropical forms having been reduced almost to mere spikes, which in some species never pass beyond a rudimentary state. . . .

A paper published in 1871 "On the Mammals and Winter Birds of East Florida, with an Examination of certain assumed Specific Characters in Birds" brought forth the following comment from Coues:

The article gained the Humboldt Scholarship, and is one of the most important of American ornithological works.

His work in taxonomy covered almost the entire mammal fauna of the world, from marsupials to monkeys, from shrews to whales, while his field of research has been at times in every one of the continental areas. The greater number of his papers are systematic taxonomic reports and the descriptions of new forms. He is the author of nearly seven hundred new mammal names, and fifty-three bird names.

Some of the most important of the accomplishments of Dr. Allen have been his labors in the field of scientific nomenclature, a field where authoritative workers are scarce because of the exacting demands of the problems. His knowledge of scientific literature was so deep, his memory for authors and dates so unusual, that he took particular delight in the solution of the weightest nomenclatural problems. His opinions command respect from scientists the world over and this fact has long been recognized in the positions held by the doctor on committees on nomenclature of both national and international organizations. It is in this field that the loss of his contributions will be most keenly felt.

He was a member of the Commission on Nomenclature of the International Congress of Zoology since 1910 and attended the meeting in Monaco in 1913.

A man of extreme modesty and retiring temperament, indeed bashful, he strove for no titles, sought for no publicity. Honors, however, came to him unasked. In 1886 he was granted the degree of Ph.D. by Indiana University; in 1903, he was awarded the Walker Grand Prize, Boston Society of Natural History, and in 1916 the Medal of the Linnæan Society of New York. He was a fellow or member of no less than thirty-three scientific societies in the United States and abroad.

He held high positions in many scientific organizations, the more important being that of president of the American Ornithologists Union, 1883–1891; an incorporator of the (first) Audubon Society for the Protection of Birds, 1886; a Founder and Director of the Audubon Society of the State of New York, 1897–1912; Vice-president of the New York Academy of Sciences, 1891–1894; President of the Linnæan Society of New York, 1890–1897; etc.

Dr. Allen possessed to a rare degree the faculty of concentration and devotion to his work. Not content with the amount of work done at his office in the museum, he carried books and material home with him, and his ideal vacation was one where he might take some special subject away with him where he could study unmolested. In brief, he lived for his work and to the psychology of this devotion may possibly, in part, be attributed his ripe age, attained in spite of long periods of ill health.

No one associated with Dr. Allen could fail to be impressed, not only with the very evident scholarly attainments of the man, but with his sincerity and simplicity. From a profound respect for his work, one passed readily to a love for the man, and an association with him in any work could be counted, not only as a most valuable mental training, to be prized in later years, but as a friendly contact no less to be remembered.

Dr. Allen married, in 1874, Mary Manning Cleveland and a son, Cleveland Allen was born to them. His wife died in 1879 and for seven years the doctor remained single. In 1886 he

married Susan Augusta Taft, who with his son Cleveland survives him. Dr. Allen's home life was idyllic and to this inspiration he was wont to attribute the achievements of his later life and the activity of his older years.

With the passing of Dr. Joel Asaph Allen the world has lost an earnest and sincere student, natural science has lost the power of an able pen backed by the searching analysis of level judgment, while his personal friends will mourn the loss of all this and more, for they have known him as a man.

H. E. Anthony
American Museum of Natural History

SCIENTIFIC EVENTS

THE DANISH DEEP-SEA EXPEDITION

We find in *Nature* an account of the Danish Deep-Sea Expedition, which left Copenhagen on August 30 on board the new research steamer *Dana*. It plans to spend about ten months in the temperate and tropical parts of the North Atlantic. The object of the expedition is to carry out deep-sea investigations in accordance with a scheme which was submitted by the leader of the expedition, Dr. Johs. Schmidt, to the International Council for the Exploration of the Sea during their meeting at Copenhagen in July last.

The *Dana*, of the Lord Mersey trawler type, was bought in England by the Danish Government to replace the old research steamer *Thor*, which was sold some years ago. The *Dana* has been equipped for marine research work at the Royal Dockyard, Copenhagen. She has a length of about 140 ft. between perpendiculars, and is 325 tons gross register. She carries a 600-h.p. triple expansion engine, giving her a speed of 9 knots. A large deck-house has been constructed, which contains two laboratories—a larger biological laboratory with accommodation for five workers, and a smaller one for hydrographical work with room for two—together with a mess-room for the scientific staff, and a cabin for the leader of the expedition. Below deck are the cabins of the scientific staff, and store-rooms for the various instruments, fishing gears, collections, etc. The winches are worked by steam. A big trawl-winch placed forward has two drums, the smaller carrying 4000 meters of steel wire 14 mm. in diameter for trawling at moderate depths, and the larger, carrying 10,000 meters of steel wire tapering from 14 mm. to 7 mm. in diameter, to be used for greater depths. The three winches for vertical hauls (water-bottles, plankton nets, and sounding) are placed on the port side of the ship; one works the Lucas sounding machine and a drum carrying 6,000 meters of phosophor-bronze wire; another is a small hand-winch to be used for the surface layers; and the third works a big drum carrying 10,000 meters of steel wire 4 mm. in diameter. The steel-wire ropes have been supplied by Messrs. Craven and Speeding Bros., Sunderland, and the hydrographical instruments by the Laboratoire Hydrographique, Copenhagen, of which Professor Martin Knudsen is director.

The *personnel* of the expedition is as follows:—Dr. Johs. Schmidt, leader of the expedition; Dr. J. N. Nielsen (Meteorological Institute, Copenhagen), hydrographer; P. Jespersen and A. V. Taaning (Danish Committee for the Study of the Sea); K. Stephensen (Zoological Museum, Copenhagen); J. Olsen (Polytechnic College, Copenhagen), assistant hydrographer. N. C. Anderson, ship's doctor, will also take part in the investigations. Professor C. H. Ostenfeld expects to join the expedition later on during its stay in West Indian waters.

THE FIFTH AVENUE HOSPITAL OF NEW YORK

The Fifth Avenue Hospital Association is making an urgent plea for contributions to complete the construction of the new building at 105th Street and Fifth Avenue. The institution will combine the present Hahnemann Hospital and the Laura Franklin Free Hospital for Children. Dr. Wiley E. Woodbury, director of the hospital, has made a statement for the New York *Evening Post* in which he says:

There is an enormous waste in the administration of the free ward, which is not realized by any

except those who have had direct experience with it. This waste will be eliminated to a large extent by housing patients in separate single rooms. And the keynote of the whole thing will be the flexibility of the service.

In the first place, it is the business of a hospital to cure people. No one will say that noise, confusion and unsightliness are conducive to cure. A separate room for each patient together with other provisions for privacy and comfort in this new hospital will eliminate noise, confusion, and unsightliness—and with them, fear. What that will save in energy and worry to doctor and nurse and patient is incalculable.

Next, the single-room system will save the nurse's time. In the ordinary ward all the supplies are kept at the end of the ward, and the nurse has to travel its entire length to get what she requires every time she goes to any one of the beds. We shall have each patient's equipment at the patient's bedside and save the nurse's time and strength.

Every bed will be working 100 per cent. We shall not be troubled by the necessity for sex segregation or disease classification.

With the ward system there is often a waiting list for the women's surgical ward, while several beds are empty in the men's ward. This means that two things happen: People who urgently need surgical treatment are denied it and empty beds add their quota to the overhead without working for it.

Again, in the classification of diseases, the maternity ward of the old type hospital may be half empty and the surgical and medical wards full. Yet it is impossible to put surgical and medical cases into a maternity ward, for fear of infection. That means more beds wasted, also heat and light and service. It is equally wrong to put children with adults. But in a wardless hospital in case of an epidemic among children the children can easily be put into adults' rooms.

Pneumonia and typhoid patients should never be put in open wards at all, because it is impossible to control the source of infection. These cases need varying temperatures; some, moreover, are of a virulent form and some are not; and some may be fairly safe at the start and develop into virulent cases later and infect others.

I have often seen a fifteen-bed ward occupied by only two patients. Of course, in cases like this it would be cheaper to put the patients into single rooms and close the wards; but frequently there is no single room vacant, and all the heat and service and light and equipment needed for fifteen people have to be expended upon two.

On the other hand, when a single room is unoccupied the lights are put out, the heat is turned off, the door is locked—and that room costs nothing for upkeep until it is occupied again.

Occupants of wards are invariably distressed by the rigid rules concerning visiting hours. These rules are necessary. People who are critically ill and those who are convalescent are all together in the same ward. Their requirements, of course, are different—those who are recovering need to be amused, to see their friends; and this is sure to disturb the critically ill even during a very limited visiting period. When all are in separate rooms, visiting hours will be limited only by the physician in charge.

The advantages in respect to ventilation and other conditions which should vary with varying types of illness are obvious. A pneumonia patient and one recovering from an operation need totally different conditions, and only by separating them can the greatest comfort be secured for each.

THE EMPLOYMENT OF MENTAL DEFECTIVES IN ENGLAND

ACCORDING to the *British Medical Journal*, the special schools after-care committee of the City of Birmingham Education Committee has the duty of keeping a record of the subsequent history of former pupils in the special schools for the mentally defective. The total number of cases included in its records has increased from 2,282 in the year 1919 to 2,504 during the past year, males numbering 1,503 and females 1,001. These figures indicate very clearly the ratio of three boys to two girls, which is frequently found in the various special schools for the mentally defective. Of the 2,504 cases in last year's records, 969 are doing remunerative work, 913 of these earning wages which average 30s. 10d. per week, while 56 are soldiers. The general depression in industrial and trade conditions has naturally had an effect upon the mentally defective cases in employment, and, while the number of men and youths under review this year has increased from 1,380 to 1,503, the number in employment has only risen from 630 to 655; the number of women and

girls in employment has actually decreased from 320 to 314, although the total number of cases reported on has grown from 902 to 1,001. During the war, and for some time afterwards, no difficulty was experienced in procuring situations for such mentally defective persons as were capable of employment, but under the present conditions of industry considerable difficulty arises. The earnings of those, however, who have remained in employment show the general upward tendency which wages had during 1920, and three men are each reported as able to earn £5 per week, while two others in business on their own account are reported to be making comfortable livings. The percentage of cases in institutions again decreased last year, and the committee says it finds that institutional accommodation for the mentally defective continues to be deplorably inadequate throughout the country as a whole.

BUREAU OF SPECIAL EDUCATION IN OHIO

THE eighty-third General Assembly of Ohio appropriated $10,000 "for the training of teachers for subnormal and delinquent children." One sentence in an appropriation bill provided that this sum should be transferred to one of the state colleges of education "to be designated by a committee composed of the director of juvenile research, the president of Ohio University, the president of Miami University, the superintendent of Bowling Green State Normal School, and the superintendent of Kent State Normal School for such purposes." On December 30, 1920, the committee decided to place the work under the administration of Miami University. Practically all the initial appropriation was used for the purchase of psychological, anthropometric and medical apparatus, intelligence and educational test blanks, office and classroom furniture and equipment, material for special class work, a piano, a victrola, a portable projector, a Burroughs adding machine, etc., and the payment of salaries up to the end of the fiscal year, July 1, 1921.

Instruction was first offered in the summer session under the temporary direction of Dr. J. E. Wallace Wallin, who has been director of the psycho-educational clinic and special schools in St. Louis during the past seven years, and who during the preceding four years was director of laboratories of clinical psychology and anthropometry in the State Village for Epileptics in New Jersey and the University of Pittsburgh, and who has offered courses for the training of teachers and examiners of abnormal children during the last eleven years in the Vineland Training School, the Universities of Pittsburgh, Iowa, California and Montana, and the Harris Teachers College of St. Louis.

Dr. Wallin has been retained as permanent director of the department, which is known as Bureau of Special Education. The present staff includes, in addition to the directors, one assistant to the director, one stenographer on part time, and two critic teachers, a part of whose salaries is paid by the local school districts in which are the observation and practise centers. The main practise center during the present year is in Hamilton. It is hoped to locate the bureau eventually in a large city, which will afford, in connection with the public-school system, ample opportunities for observation and practise teaching in many kinds of special classes and which will also afford superior clinical advantages.

A FOREST EXPERIMENTAL STATION AT ASHEVILLE, NORTH CAROLINA

THE continued steady depletion of the timber supply in the Appalachian region has led the Forest Service of the United States Department of Agriculture to establish a new forest experiment station at Asheville, North Carolina. This is the first organization of its kind to be established in the eastern United States.

The staff will be engaged mainly in silvicultural research to secure information greatly needed for the proper management of forest lands in order to insure a continuous supply of timber and other forest products. E. H. Frothingham has been appointed director. He comes to the station with a background of over twelve years of investigative work with the Forest Service throughout the east-

ern United States. The other members of the staff are E. F. McCarthy, for nine years a member of the teaching staff of the New York State College of Forestry at Syracuse University and recently research specialist with the Canadian Conservation Commission; C. F. Korstian, at one time a member of the staff of the Fort Valley Forest Experiment Station and recently in charge of research in the Intermountain District of the U. S. Forest Service, Ogden, Utah; and F. W. Haasis, until recently a member of the investigative staff of the Fort Valley Forest Experiment Station near Flagstaff, Arizona.

THE INSTALLATION OF PRESIDENT FARRAND AT CORNELL UNIVERSITY

Dr. Livingston Farrand was inaugurated president of Cornell University on October 20. Chief Justice Frank H. Hiscock of the New York State Court of Appeals made an introductory address as chairman of the board of trustees of the university. Acting President Albert W. Smith, formerly dean of Sibley College of Engineering, delivered the seal and charter of the university to President Farrand.

President Farrand then gave his inaugural address, which was on the world situation following the war and the service that the universities should offer.

Following President Farrand's address Dean William A. Hammond spoke for the faculties of the university and Mr. Foster L. Coffin for the alumni.

President A. Lawrence Lowell of Harvard, President M. L. Burton of Michigan, and President R. L. Wilbur of Leland Stanford, Jr., brought the greetings from the universities of the East, Middle West, and West respectively. President Harry W. Chase of the University of North Carolina, who was unable to be present, telegraphed the greetings of the Southern colleges.

Finally Governor Miller presented greetings from the State of New York.

At the dinner in the evening in addition to President Farrand the speakers included President James R. Angell of Yale University, Sir Robert Falconer, president of the University of Toronto, and Dr. Liberty Hyde Bailey.

Coincident with the inauguration of Dr. Farrand came the disclosure that the anonymous benefactor who gave $1,500,000 to Cornell for a new chemical laboratory is Mr. George F. Baker, chairman of the board of directors of the First National Bank of New York. Mr. Baker attended the exercises and laid the corner stone of the laboratory.

Professor E. L. Nichols made an introductory address, which was followed by the main address of the day by Dr. Edgar Fahs Smith, provost emeritus of the University of Pennsylvania and president of the American Chemical Society. Mr. Charles M. Schwab, a trustee of Cornell University, spoke for Mr. Baker.

SCIENTIFIC NOTES AND NEWS

Dr. George S. Crampton was elected president of the Society of Illuminating Engineers at the recent Rochester meeting.

Professor Henry S. Jacoby, for thirty-one years a member of the college of civil engineering of Cornell University and for twenty-one years head of the bridge engineering department, will retire from active service at the close of the college year.

Robert Stanislaus Griffin, for more than eight years head of the Bureau of Engineering of the Navy Department and engineer in chief of the U. S. Navy, has retired from active service.

The Morris Liebman Prize, the cash award made each year by the Institute of Radio Engineers to that member of the institute who is considered to have made the most important contribution to radio art during the preceding twelve months, has been awarded to R. H. Heising, of the engineering laboratory of the Western Electric Company, "for his analysis of vacuum tube action and his research work on modulation systems."

The first award of the Marcel Benoist Prize of 20,000 francs has been made to M. Maurice Arthus, director of the Institute of Physiology at Geneva. The prize was founded by M. Benoist of Paris, who bequeathed his whole fortune to the Federal Council of Switzerland in recognition of the care and attention which he

received in that country. An award will be made annually to the man of science who, having been domiciled in Switzerland for five years, is judged to have made the most noteworthy contribution to science, particularly in relation to human life, during the preceding year.

Professor Guiseppe Tomassi has been appointed director of the Royal Institute for Agricultural Chemistry in Rome.

Professor Henry Louis has been elected honorary secretary of the Institute of Mining and Mechanical Engineers of the north of England.

The Kindborn Prize of the Swedish Academy of Sciences at Stockholm has been divided equally between Professor Sven Oden for his work on precipitation and C. Lönnquist for his investigation on the temperature of the interior of the earth.

We learn from *Nature* that the Committee of Privy Council for Medical Research has appointed Sir F. W. Andrewes and Sir Cuthbert Wallace to fill the vacancies on the Medical Research Council caused by the retirement of Mr. C. J. Bond and Professor W. Bullock, in accordance with the provisions for rotation made in the Royal Charter under which the council is incorporated.

Mr. D. Prain, agriculturist, Nyasaland, has been appointed to be senior district agricultural officer in Tanganyika Territory; Mr. H. A. Dade to be assistant mycologist in the Department of Agriculture, Gold Coast; and Mr. J. A. Robotham to be assistant agricultural superintendent, St. Kitts-Nevis.

The American School in France for Prehistoric Studies has completed its first term's work in Charente, Dordogne, Corrèze, and the French Pyrénées. Professor George Grant MacCurdy of Yale University, director of the school, has returned to Paris for the winter term.

After two years spent as adviser to the food minister of Poland, E. Dana Durand, professor of economics in the University of Minnesota, has returned to the United States, and has been appointed chief of the eastern European division of the Bureau of Foreign and Domestic Commerce.

Dr. C. Eugene Riggs, president of the Minnesota State Medical Association, gave a Mayo Foundation lecture at Rochester, Minn., on October 4. Dr. Riggs repeated his presidential address, "Minnesota medicine in the making; personal reminiscences," which he gave at the meeting of the Minnesota State Medical Association, in Duluth, on August 24. Dr. Cyrus Northrop, ex-president of the University of Minnesota, delivered a Mayo Foundation lecture on general education on October 11.

Professor Edgar James Swift, head of the department of psychology and education in Washington University, has been invited to give three lectures before the student officers of the Post Graduate School of the U. S. Naval Academy at Annapolis. The first lecture, "The Psychology of Managing Men," was given October 8; the second, "Thinking and Acting," will be given January 28, and the third, "The Psychology of Testimony and Rumor," April 8.

The Harveian Oration before the Royal College of Physicians of London will be delivered by Dr. Herbert Spencer on October 18. The Mitchell lecture by Dr. Parkes Weber, on the relation of tuberculosis to general conditions of the body and diseases other than tuberculosis, will be given on November 1. Dr. Michael Grabham will deliver the Bradshaw lecture, on subtropical esculents, on November 3. The Fitzpatrick lecture, on Hippocrates in relation to the philosophy of his time, will be given by Dr. R. O. Moon, on November 8.

The following public lectures were given during October at University College, London: Beginning October 10 Professor Eliot Smith gave the first of three lectures on The Beginnings of Science; on October 12 Dr. A. Wolf began a series of lectures on the general history and development of science; and October 14 Dr. J. C. Drummond began a course of eight public lectures on nutrition.

The fourth annual Streatfeild memorial lecture was delivered at the Finsbury Techni-

cal College, London, by Mr. W. P. Dreaper, on October 20. The subject was "Chemical Industry a Branch of Science."

The death is announced of Dr. Albert Sidney Leyton, professor of pathology at the University of Leeds, Great Shelford, Cambridge, aged fifty-two years. His death is said to be directly due to his war service. He was a major and served as bacteriological consultant to the Northern Command, and it was during his investigations of trench fever that he developed the malady from which he died.

The British Association has marked its appreciation of the plan for establishing the Brent Valley Bird Sanctuary as a permanent nature reserve in memory of Gilbert White by making a contribution through the Selborne Society towards the upkeep and endowment fund.

To mark the recent centenary of James Watt, the Institution of Shipbuilders and Engineers has founded two new chairs in Glasgow University—a James Watt Chair of Electrical Engineering, and a James Watt Chair of the Theory and Practise of Heat.

Professor Edward Hjelt, professor of organic chemistry in the University of Helsingfors and at one time Finnish ambassador at Berlin, died on July 2 at the age of sixty-six years.

It is announced that the annual meeting for 1922 of the British Medical Association will be held at Glasgow on July 21–29.

We learn from the *Journal of Industrial and Engineering Chemistry* that the appointment of the permanent chief of the Bureau of Chemistry has been delayed because of the impossibility of finding a properly qualified chemist who is willing to take the position at the $5,000 salary attached to it. As a result of this situation, an increase in appropriation to $7,500 will be asked, but under present conditions no congressional action is likely before the middle of next year.

The Knud Rasmussen expedition left Godthaab, on the southwest coast of Greenland, on September 7. The London *Times* states that the motor schooner *Sea King* during August had been to Thule (northwest Greenland) and brought back the Eskimo members of the expedition, four men and three women, as well as 72 dogs, sledges and furs which excel anything previously known. Part of the clothing sent from Denmark and lost in the shipwreck of the *Bele* has been replaced, and the expedition starts with as good an outfit as possible. In regard to *personnel,* the expedition unfortunately is less lucky. First Peter Freuchen's Eskimo wife Navarana, who was going to follow her husband, died at Upernivik on August 3, and during their southward journey the Cape York Eskimos caught cold which developed into pneumonia. After their arrival at Godthaab they were taken to hospital, where one, the huntsman Iggianguak, who had taken part in some of the previous Thule expeditions, died. The others had so far recovered that the doctor permitted them to rejoin the expedition. The *Sea King* will first go to the coast of Labrador, where M. Lindow, one of the Greenland trade inspectors, will carry on scientific investigations. It will then proceed with Rasmussen's party to Lyon inlet, in the Melville Peninsula. Captain Pedersen will afterwards take the vessel to St. John's, Newfoundland, from which the next report will be sent. The object of the expedition is to explore and map the archipelago between Greenland and the American continent, and also to investigate the migrations of the Eskimo, their folk-lore, and cognate subjects.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Jonathan M. Parmenter, of Wayland, Mass., a trust fund of over $250,000 is left to Harvard College for the establishment of scholarships.

Dr. John Lee Coulter has been elected president of the North Dakota Agricultural College. He takes the place occupied by Dr. E. F. Ladd, who was elected to the United States Senate last March.

Dr. K. G. Matheson, president of the Georgia School of Technology since 1906, has resigned to become president of Drexel Institute. Dr. Matheson will go to Drexel next spring, probably April 1. Until then the institute will continue to be directed by the administrative board, which took charge upon the recent retirement of Dr. Hollis Godfrey.

Dr. Franklin Stewart Harris was installed as president of Brigham Young University at Provo, Utah, on October 17. Dr. Harris, who was formerly director of the Utah Agricultural Experiment Station, succeeds President George H. Brimhall, who becomes president emeritus.

Dr. Frank Pierrepoint Graves, formerly head of the school of education of the University of Pennsylvania, who succeeds Dr. John H. Finley as commissioner of education of New York State, and president of the University of the State of New York, was inducted into office on October 20.

Dr. Harry W. Crane, assistant professor of psychology at Ohio State University, has been called to an associate professorship in psychology at the University of North Carolina. He will also act as psychiatrist to the State Board of Public Welfare.

DISCUSSION AND CORRESPONDENCE

A BIRD'S-EYE VIEW OF AMERICAN LANGUAGES NORTH OF MEXICO

It is clear that the orthodox "Powell" classification of American languages, useful as it has proved itself to be, needs to be superseded by a more inclusive grouping based on an intensive comparative study of morphological features and lexical elements. The recognition of 50 to 60 genetically independent "stocks" north of Mexico alone is tantamount to a historical absurdity. Many serious difficulties lie in the way of the task of reduction, among which may be mentioned the fact that our knowledge of many, indeed of most, American languages is still sadly fragmentary; that frequent allowance must be made for linguistic borrowing and for the convergent development of features that are only descriptively, not historically, comparable; and that our persistently, and rather fruitlessly, "psychological" approach to the study of American languages has tended to dull our sense of underlying drift, of basic linguistic forms, and of lines of historical reconstruction. Any genetic reconstruction that can be offered now is necessarily but an exceedingly rough approximation to the truth at best. It is certain to require the most serious revision as our study progresses. Nevertheless I consider a tentative scheme as possessed of real value. It should act as a stimulus to more profound investigations and as a first attempt to shape the historical problem. On the basis of both morphological and, in part, lexical evidence, the following six great groups, presumably genetic, may be recognized:

- I. Eskimo-Aleut
- II. Algonkin-Wakashan
  - Algonkin-Wiyot-Yurok
  - Kootenay
  - Wakashan-Salish
- III. Na-dene (Haida; Tlingit-Athabaskan)
- IV. Penutian
  - CalifornianPenutian
  - Oregon Penutian
  - Tsimshian
- V. Hokan-Siouan
  - Yuki
  - Hokan
  - Coahuiltecan group
  - Keres
  - Tunica group
  - Siouan-Yuchi-Muskogian
  - Iroquois-Caddoan
- VI. Aztec-Tanoan
  - Uto-Aztekan
  - Tanoan-Kiowa

This leaves the Waiilatpuan-Lutuami-Sahaptin group, Zuñi, and Beothuk as yet unplaced. The lines of cleavage seem greatest between IV. and V., and between III., on the one hand, and I. and II., on the other. Group V is probably the nearest to the generalized "typical American" type that is visualized by linguistic students at large.

E. Sapir

Canadian Geological Survey,
Ottawa

THE USE OF VITAMINE FOOD-TABLETS AS AN AID TOWARD CONSERVING THE FOOD SUPPLY [1]

In the conservation of food, it is necessary to remove the vitamines from certain staple products. Wheat flour can not be conserved for a long period unless it is bolted, thereby removing all of the vitamines. Cane sugar is perfectly stable, but this stability is due to the fact that any protein or vitamine that may have been in the cane juice has been removed. The hydrogenated fats are about the most stable of the fats, and yet the vitamine content is zero. It is, therefore, highly desirable to have vitamine preparations to complete the dietary. Fresh vegetables and fruits may be had in season, but their transportation, storage and marketing are very expensive, and usually accompanied by enormous waste. There are many families who do not, under the present system, receive sufficient vitamines in their food. Therefore, some addition seems necessary, but this is clearly considered as an addition, and not as a substitute for anything. These additions may be in the form of dehydrated products. Many of the vegetables and fruits may be dehydrated and consumed in a form which will furnish the consumer with considerable vitamine, and yet not necessitate a change in the methods of preparation of foods by the family. Those dehydrated vegetables may contain vitamines *A* and *B*, and dehydrated fruits may, under certain circumstances, contain in addition some vitamine—*C*. The dietary habits of various persons, however, form an obstacle to the consumption of sufficient vitamines. There are also many persons who can relish fresh foods (spinach, for instance) when they can not stomach dehydrated foods (spinach). The peel of citrus fruits, and some other fruits, is very rich in vitamines, yet no one eats them. For those persons who do not relish certain vitamine-containing vegetable products, the use of tablets containing these products, that may be swallowed whole, seems desirable. Orange peelings ground in a meat chopper, dried and ground in a coffee mill may be made into tablets by the addition of dehydrated orange juice acting as a binder. Such tablets contain vitamines *A*, *B* and *C*. Ground spinach may be similarly made into tablets with orange juice. I have tried these preparations on animals and determined their effectiveness in regard to vitamine content. Many workers may be engaged in determining the exact vitamine content of many of these preparations[2] and I do not wish to compete with their work in this paper, but merely wish to advocate the method of swallowing this vitamine food whole, in order to avoid the censorship of the palate.

J. F. McCLENDON

[1] Contribution from laboratory of physiological chemistry, University of Minnesota.

[2] Cooper, Ethel, 1921, *Proc. Exp. Biol. Med.*, XVIII., 343.

SCIENTIFIC BOOKS

The Anatomy of the Nervous System from the Standpoint of Development and Function. By STEPHEN WALTER RANSON, Professor of Anatomy in Northwestern University Medical School. 395 pages, 260 illustrations. Philadelphia, W. B. Saunders Co., 1920.

A certain professor in an American university, through whose laboratory there annually pass between one and two hundred students of the anatomy of the nervous system, has been heard to remark, "Nobody ever learned any neurology out of a book," meaning, of course, that only by actual laboratory contact with neurological materials can one hope to master the baffling complexity of brain structure. No printed description, no pictorial illustration, not even the laboratory demonstration of elegant dissections and brilliantly stained microscopic sections, can take the place of the kinesthetic experience which each must acquire for himself by personal study, manipulation, and dissection of the tissues.

Of course, to this it may be answered that nobody ever learned much neurology without the aid of good books. And until relatively recent times the lack of suitable student manuals was probably one of the factors responsible for the futility of much of the teaching of the

structure of the brain, particularly in the medical schools, where the net result of the student's best efforts was too often the acquisition of a jargon of Greek and Latin polysyllables without meaning or interest except to the antiquarian—and the examining board. Other factors in the recent improvement in teaching this subject are students of better caliber and training and better teachers. Without advancement in these two directions the publication of adequate text-books could not greatly improve the situation, for the students of former days could not have used the books of to-day, and the same is probably true of not a few of their teachers.

The study of the brain is intrinsically difficult. The medical student, in particular, must master and remember a vast amount of extremely intricate anatomical detail before he is prepared to diagnose his first neurological case. Since the student can be expected to acquire at best only a very small part of the known details and to remember still less, it is essential that a selection be made for him by his teacher. And the success of the instructor will be determined as much by what he leaves out of the course as by the skill with which he organizes the irreducible minimum which he does attempt to present.

A student who is directed or permitted to memorize a long list of the absurdly cumbersome names which have been given to the visible parts of the brain without gaining a definite idea of their functional significance and interrelationships has a real grievance. And the chief pedagogical difficulty lies in just this point that the parts are so inextricably interrelated, both anatomically and physiologically, that one can not know anything of value about one of them until he knows a little, at least, about a good number of others. It is like learning a new language; the beginner must know something of its grammatical structure and vocabulary before he can read. When I began the study of Latin I was required to spend an entire year in memorizing Harkness' Grammar before I was permitted to read a line of a Latin author. I understand that languages are not taught by that method any more. The teacher of neurology, as of Latin, is faced with the problem of making the structural elements dynamic, of giving them functional values, as early in the course as possible.

The successful text-book on the nervous system, accordingly, must lay down certain general principles of the relations of structure and function, illustrate these by a judicious selection of examples, proceed in an orderly way to an examination of the gross features of the central nervous system, accompanied by an exposition of a few significant microscopic details of each part and an analysis of its functional connections with the periphery and with other centers, and finally these elements must be knit together, the related parts being woven into working systems of conduction pathways and cerebral centers, each of which has a definite part to play in the complex web of bodily adjustments. Not until the anatomical configuration and normal action of each of these several functional systems has been clearly conceived, the topographical relations of the anatomical pathways to each other in various parts of their courses visualized, and the functional patterns in which they may be combined determined, is it possible intelligently to interpret the clinical pictures presented by nervous disorders or to make any diagnosis of a neurological case by other than rule-of-thumb methods.

Dr. Ranson's book very satisfactorily meets these severe requirements. The learner is skilfully guided from the start in his selection of topics and the order in which to take them up by an analysis of the physiological factors in the organization of the nervous system which is simplified as far as the intricacies of the subject permit. The presentation is clear, logical, and accurate. The illustrations are judiciously chosen, many of them are original drawings which are important additions to the literature, and they are beautifully executed. The publishers, too, have done their work admirably, text and figures are well printed, typography clear, and misprints very few. Most of the figures are based on the human nervous system, but there are included excellent drawings of the brains of the dogfish and sheep which

are of especial value for those laboratories in which these types are used to supplement human material.

The unavoidable difficulties of the study of the nervous system are further increased by an unnecessarily cumbersome nomenclature. Ranson has followed in the main the B. N. A. system of terms, wisely using English forms of the names in most cases. This system has at least the merit that it is possible to find out exactly what its names mean. Like nearly all other recent anatomical writers, he departs from this system in some respects (*e.g.*, dorsal and ventral for posterior and anterior. Pending the international revision of the B. N. A., which is perhaps more urgently needed in neurology than elsewhere, it is desirable that certain other changes be widely adopted. The "pons" of the B. N. A. is a hybrid monster, for whose continued existence there is no justification, anatomical, physiological, embryological or comparative. Other similar infelicities might be mentioned.

As indicated at the beginning of this review, the serious study of the nervous system can not proceed far without practical work, and Ranson's book is so organized as to follow the natural sequence of laboratory study. A brief laboratory outline is included in the final 20 pages.

The author has attempted to include within the covers of one book all that the medical student requires for his guidance in a first course on the anatomy of the nervous system, and this task has been well done. That this plan is very acceptable to the student, there can be no question, but in the reviewer's experience this is not an unmixed benefit. With a manual of this sort in his hands it is the very exceptional student who can be induced to consult the atlases and larger works of reference and the periodical literature which he must learn to use if he would win an adequate preparation and the proper outlook for successful work in neurology. The question may be raised whether from the pedagogical standpoint the symmetry and completeness of this work are, after all, really advantageous.

C. Judson Herrick

SPECIAL ARTICLES

A SIMPLE APPARATUS FOR MICRO-MANIPULATION UNDER THE HIGHEST MAGNIFICATIONS OF THE MICROSCOPE

The microdissection and microinjection of marine ova and of animal and plant cells have hitherto been carried out by means of Barber's[1] pipette holder, an instrument primarily intended for the isolation of bacteria. Barber's instrument had the big advantage over other similar mechanisms in that it enabled one to manipulate needles in a drop hanging from a coverslip suspended over a moist chamber. This eliminated all obstacles between the objective and the coverslip, thereby permitting the use of high-power objectives.

The method of making the glass microneedles and pipettes is described in full in Barber's various papers dating from 1904 to 1914 and in a paper of mine[2] in which the application of the method to microdissection is given.

The principle involved in Barber's apparatus is a carrier pushed along a groove by a screw at one end. By having a series of three carriers built up on one another, each travelling in a different direction, movements in any one of three dimensions may be imparted to a needle clamped on the top carrier. It is difficult to construct this instrument in such a way that each movement can be maintained in a precise focal plane. Even when skilfully made, wear and tear in time renders the movements jerky and undependable.

The instrument described in this paper has the following advantages over Barber's: (*a*) simple construction, (*b*) absence of any lost motion no matter how long the device is used, (*c*) accurate and constant control of the movements of the needle or pipette tip

[1] Barber, M. A., 1904, "A new method of inoculating microorganisms," *Jour. Kans. Med. Soc.*, IV., 487; 1914, "The pipette method in the isolation of single microorganisms and in the inoculation of substances into living cells," *The Philip. Jour. Sc.*, Sec. B, Trop. Med., IX., 307.

[2] Chambers, R., 1918, "The microvivisection method," *Biol. Bull.*, XXXIV., 121.

under the highest magnification of the microscope, (*d*) maintenance of the needle tip in one focal plane while it is being moved back and forth in any of the three directions. The basic principle of the instrument consists of rigid bars which are screwed apart against springs. The movements imparted are in arcs of a circle having a radius of from three to four inches. The arcs produced by the two lateral movements lie in one horizontal plane so that the needle tip does not drop out of focus during these movements. The curvature of the arc is unnoticeable as the extreme range of movements of the fine adjustments is only 3 mm. In the microscopic field no movement over one millimeter is ever required.

A full description of this instrument with photographs and diagrams is being published in the *Anatomical Record* and, possibly, in the *Journal of Bacteriology*. The principle on which the instrument depends is in the process of being patented.

The principle is demonstrated on considering the mechanism for the movements in one plane only (Fig. 1). This consists of three

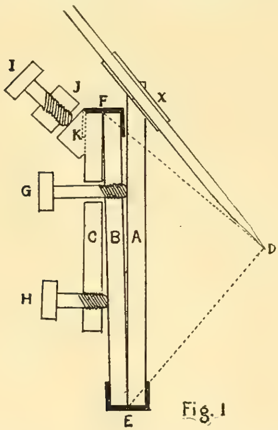

Fig. 1

bars of rigid metal connected at their ends to form a Z-like figure by resilient metal acting as a spring hinge.

By the action of certain screws the bars can be forced apart; on reversing the screws the bars return to their original position owing to the spring action at the ends of the bars. By these means arc movements may be imparted to the tip of a needle when placed in the proper position, and these movements are fine and steady enough to be under perfect control when viewed under the highest powers of the microscope.

The needle or any instrument the tip of which is to be manipulated is held in a carrier fastened to the free end of a bar *A* at *X*. The needle is made to extend so that its tip is at the apex of an imaginary triangle at *D*.

In order to obtain two movements at right angles to one another in the horizontal plane the tip of the needle must be at the apex *D* of a right-angled isosceles triangle, the base of which is a straight line joining the centers *E* and *F* of the springs holding the three bars, *A*, *B* and *C*, together. The shank of screw *G* passes through a large hole in bar *C* and is screw-threaded in bar *B*. Turning screw *G* spreads bars *B* and *A* apart thus imparting an arc movement to the needle tip at *D*. The other screw *H* is screw-threaded in bar *C*. Turning it spreads apart bars *C* and *B* and imparts an arc movement to the needle tip at *D* at right angles to that procured by turning screw *G*.

The movement in the vertical plane at right angles to the afore-mentioned movements is procured by screw *I* (Fig. 2), which

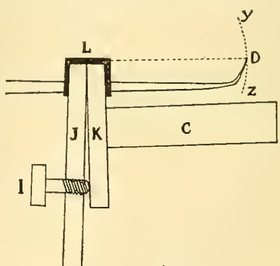

Fig. 2

is screw-threaded in a rigid vertical bar *J*

and abuts against a vertical extension K of the bar C. The extension K is parallel to the bar J and is connected to it at its top by means of a solid spring hinge. Turning screw I spreads apart bars J and K and lifts the whole combination (A, B and C) and imparts an arc movement in the vertical plane to the tip of the needle at D. To procure a vertical movement the tip of the needle at D must lie in the same horizontal plane L–D with the spring fastening K and J together. When screw I is turned the needle tip will then move in an arc Y to Z more nearly vertical than any other arc on the same circumference of which the point D is the center.

The rigid bar J can be attached directly to the stage of the microscope, or it may consist of a pillar rising from a metal base. In the latter case the microscope is clamped to the base alongside the pillar. In both cases the needle carrier X (Figs. 1 and 2) is arranged to allow the needle to project over the microscope stage with its tip in the field of the microscope objective.

This instrument can be used singly for one needle or with a companion when two needles or a needle and a pipette are to be used simultaneously. When a pair is to be used, one is a left-handed and the other a right-handed instrument.

There are two models of the micro-manipulator, a simple and a more elaborate form. Both are identical in the accuracy and extent of the fine movements. The advantages of the elaborate over the simple form are (1) great steadiness, (2) independence of the microscope from the apparatus and (3) special features for the preliminary adjustments of the needle or pipette.

In the elaborate form the manipulator is fastened on a pillar independent of the microscope. The pillar is screwed into a heavy base to which the microscope is clamped. This ensures great steadiness. The microscope can be removed at any time, thus facilitating greatly the exchange of needles and the preparation of the apparatus for micro-injection. Also the coarse adjustments are controlled by screws which aids greatly in the preliminary adjustments of the needle or pipette when bringing it into the focal field of the microscope.

The simple form is more compact and can be clamped directly to the stage of the microscope. Its steadiness, therefore, depends upon the steadiness of the microscope stand. The preliminary coarse adjustments of the needle depend upon sliding movements which are operated by hand. They are, therefore, less readily performed than in the case of the elaborate form. However, the essential feature of the instrument is in the fine adjustments and these are identical in their accuracy in both forms.

A very convenient combination is a left-handed needle manipulator of the elaborate type including the base and a right-handed manipulator of the simple type. On the other hand, the simple form either singly or with both a right- and a left-handed manipulator, is very serviceable.

Robert Chambers

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CHROMOSOME RELATIONSHIPS IN WHEAT

In 1917 the writer found the chromosome number of *Triticum durum* to be 28 in the fertilized egg cell. Since the number of chromosomes in wheat had been previously reported as 8 by a number of other investigators a systematic study of the chromosome number of the species of wheat was undertaken, together with a study of sterility in interspecific crosses already in progress. This work has been interrupted and in the meantime Sakamura[1] and Kihara[2] have published short accounts of the chromosome numbers in wheat. Their work seems to have received little attention, possibly due to the lack of convincing illustrations.

The writer has found the same chromosome numbers as reported by Sakamura. Einkorn has 7 haploid chromosomes; the Emmer group, consisting of *T. dicoccum*, *T. durum*, *T. turgidum* and *T. polonicum*, has 14 haploid chro-

[1] *Bot. Mag. Tokyo*, Vol. 32, 1918.

[2] *Bot. Mag. Tokyo*, Vol. 33, 1919, and Vol. 35, 1921.

mosomes, and the Vulgare group, consisting of *T. vulgare* and *T. compactum,* has 21 haploid chromosomes.

A study of the sterility relationships of species crosses has already been completed and is of considerable interest in connection with the chromosome number. Einkorn with 7 chromosomes crossed with members of the Emmer group with 14 chromosomes or with members of the Vulgare group with 21 chromosomes, results in almost totally sterile F_1 plants. Members of the Emmer group crossed with members of the Vulgare group result in only partially sterile F_1 individuals. Species within each group are inter-fertile.

A review of the wheat crosses made reveals the fact that practically the only hybrids of economic importance are crosses within the Vulgare group. The Emmer group possesses many valuable characters such as drouth and rust resistance, and certain varieties are heavy yielders under some conditions. Many crosses have been made between the members of the Emmer and Vulgare groups, but very few, if any, of the segregates have combined the desirable characters of both parents. It is possible that all F_1 gametes containing approximately half Vulgare chromosomes and half Emmer chromosomes are sterile and only gametes containing nearly all Vulgare or nearly all Emmer chromosomes survive. East[3] has suggested that such behavior may occur in certain Nicotiana hybrids which are partially sterile. Work now in progress makes this conclusion rather doubtful for wheat hybrids. An analysis of six characters involving 80 F_2 individuals of a cross of *T. durum* $\times$ *T. vulgare* does not indicate that there is greater sterility in the intermediates than in seregates resembling the parents.

There is a rather striking correlation between chromosome number and adaptability among the species of wheat. Einkorn with only 7 haploid chromosomes is of practically no economic value. In the United States it is grown only for experimental purposes. In the Emmer group with 14 haploid chromosomes, *T. durum* is the only species grown commercially in this country. The durum wheats are for the most part limited to the plains of the Dakotas and Montana. The Vulgare group with 21 chromosomes is in general the most adaptable of the three groups of wheat. It is grown in practically all parts of the United States from Maine to California, in humid sections of the central states, and on the semiarid plains of the western states. There is certainly a high degree of correlation between chromosome number and adaptability of the species of wheat, but it would be difficult to prove that adaptability is due primarily to differences in chromosome number.

The fact that the chromosomes are in multiples of 7 suggests that the species having 14 and 21 chromosomes are the result of reduplication of the 7 chromosomes of Einkorn or wild wheat. There is some evidence that the larger chromosome numbers are due to reduplication rather than fragmentation. If we assume that the size of a given cell is dependent on the chromosome content, the relationship of the three groups of wheat species becomes clearer. We have found that the volume of the mature pollen grains, measured in thousands of cubic microns, is about 72 for Einkorn, 94 for the Emmer group, and 114 for the Vulgare group. The differences in chromosome numbers of the three groups of species are closely associated with corresponding differences in size of pollen grains.

In the reduction divisions of the F_1 hybrids of crosses between members of the Emmer and Vulgare groups we find additional evidence that the larger chromosome numbers are the result of reduplication rather than fragmentation. When the chromosomes pair for the reduction division we find only 14 pairs of chromosomes and 7 single chromosomes on the heterotypic plate. The members of the paired chromosomes separate and pass to the poles leaving the 7 single chromosomes on the equatorial plate. These single chromosomes ultimately divide and pass to the poles. If the 21 chromosomes of the Vulgare group are the result of fragmentation we should expect that homologous segments

[3] *Proc. Amer. Phil. Soc.*, Vol. 54, 1915.

segments of the 14 chromosome group and that no single unpaired chromosome would be present in the reduction divisions.

If the 14 and 21 chromosome species are the result of reduplication we might expect a considerable number of characters in the Emmer and Vulgare groups to be dependent on multiple factors. Although many characters of these groups are apparently dependent on single factors there are a number of characters dependent on two or more factors. The red color of grain may be determined by one, two or three factors, and pubescence of chaff and color of chaff have also been found to be dependent on several factors in some cases. A comparatively large number of multiple factors affecting the same qualitative characters are reported in wheat.

If the Vulgare group, the Emmer group, and Einkorn differ only in chromosome combination of 7×3, 7×2, and 7×1, why should the different groups result in sterile or partially sterile F_1 plants and why should the different groups vary so greatly in morphological characters? Morgan has suggested that for similar cases in other plants that changes may occur in the individual chromosomes in the course of time so that the original chromosomes would come to differ in many factors. If the 14 and 21 chromosome species have originated by reduplication of the 7 chromosome group such changes must have occurred. The species within each group overlap considerably, but each group is relatively distinct in morphological characters.

Karl Sax

Maine Agricultural Experiment Station,
May 6, 1921.

ASTRONOMICAL MEETING AT THE POTSDAM ASTRONOMICAL OBSERVATORY

The following is an abstract of a German press report of the international astronomical meeting held at Potsdam, August 24–27 last.

After a lapse of eight years the Astronomical Society met again at Potsdam, under the presidency of Professor Strömgren of Copenhagen. Representatives from sixteen nations were present. About two hundred attended the meeting; from Scandinavia, Professor Bohlin, Stockholm; Professor v. Zeipel and Amanuens Asklöff, Upsala; Professor Strömgren and assistant Miss Vinter-Hansen, Copenhagen; from Christiania, observer Lous, and from Finland Furuhjelm; from Holland Professor Kapteyn as well as Van Rhejn and Father Esch; from England Professor Eddington, also Father Cortie, S.J.; among others were Professors Bauschinger, Hartwig, Einstein, Grossman, Nernst, Runge, Schorr, Wiechert, Prey, and Kienle.

Professor Strömgren in his address referred to the continuance of the communication of astronomic phenomena during the years of stress through the instrumentality of the Copenhagen observatory, instead of from Kiel. Copenhagen served also as a medium for the exchange of astronomic and scientific literature.

The scientific program contained many papers showing the progress which astronomy has made of recent years into details of which we can not here enter. However, from Father Hagen we learn of the immense masses of dark nebulæ; from Kühl (Munich) explanation was given of many hitherto unexplained astronomical phenomena shown in the telescope as well as on the photographic plate; from Zeipel we learn of the determination of the masses of the stars in the globular clusters and that they obey the same laws as the molecules in a so-called ideal gas.

Rosenberg reported on the improvement of the photo-electric method for the determination of brightness of stars. The accuracy of measurements approaches the 10,000th of a magnitude. v. Tamm (Sweden) surprised the meeting with an ingenious and simple method for the determination of the color of stars photographically with a single exposure. Professor Oppenheim (Vienna) presented an interesting theory on the movement of the stars. Dr. Moll of Utrecht spoke of a new microphotometer for the measurement by means of a thermopile of the distribution of brightness in stellar spectra.

A committee was appointed in connection with an expedition for observing the solar eclipse next year in the Dutch East Indies. It is intended to repeat the experiment of Professor Eddington in connection with the theory of relativity.

A visit was paid to the observatories in Potsdam and Neubabelsberg. They were shown also the Einstein tower, a new structure to further test the effect of relativity, the details of which were explained by Professor Freundlich. Professor Guthnick has been appointed director in succession to

would pair with entire chromosomes or larger

the lamented late Professor Struve. The observatory at Potsdam was shown by Professor Ludendorff, who recently has been appointed director of the Astrophysical Observatory.

A visit was paid also to the Geodetic Institute. At the wireless station the guests had the opportunity of listening to the wireless time signals from Annapolis.

One afternoon was devoted to an excursion on the Havel to the Wannsee and Nikolskee. At a tea in the library an opportunity was afforded for viewing Professor Darmstädter's collection of letters of celebrated naturalists and autographs of noted astronomers.

A feature of the meeting was the gathering in the large dome of the Potsdam Observatory, where refreshments were served and a social evening spent, the success of which was in a large measure due to the ladies of the observatory staff and others.

The four-days sessions are said to have passed without a jarring note and all parted with satisfaction at the scientific results that had been brought forth at the meeting and at the pleasure of having again renewed old friendships together with gratitude for the hospitality extended to them at Potsdam. The next meeting is to be held at Copenhagen.

AMERICAN MATHEMATICAL SOCIETY

The twenty-eighth summer meeting of the American Mathematical Society was held at Wellesley College, September 7–9, 1921, in conjunction with the meeting of the Mathematical Association of America. The attendance included ninety-one members of the Society. Eleven new members were elected, and thirty applications for membership were received.

Two joint sessions were held with the Mathematical Association of America, at which papers were read by Professor James Pierpont, on *Some mathematical aspects of the theory of relativity;* and by Professor A. C. Lunn, on *The place of the Einstein theory in theoretical physics.* The following papers were read at the regular sessions of the Society:

Einstein static fields which admit a continuous group G_2 of transformations into themselves: L. P. Eisenhart.

On the class of a certain type of Einstein spreads: John Eiesland.

The solar gravitational field and certain other fields completely determined by light rays: Edward Kasner.

Prime-power groups containing only one invariant subgroup of every index which exceeds this prime number: G. A. Miller.

General mean value relations: G. D. Birkhoff.

On plates of variable thickness: G. D. Birkhoff.

Application of least squares to the problem of apportionment: E. V. Huntington.

The summation by series by means of generating functions: I. J. Schwatt.

The expansion of any power of a multinomial: I. J. Schwatt.

The operator $(r(d/dr))$ on $F(r)$: I. J. Schwatt.

Geometric characterization of special singly infinite families of heat curves: Eugenie C. Hausle.

On the stability of a bicycle with a light frame: J. L. Synge.

Note on the definition of a linear functional: C. A. Fischer.

Certain theorems concerning simple closed and open curves: J. R. Kline.

A theorem concerning connected sets which become totally disconnected upon the removal of a single point: J. R. Kline.

Concerning connectedness im kleinen and a related problem: R. L. Moore.

The probability function for the sum of certain functions, with applications to the theory of errors: E. L. Dodd.

On power series with positive real part in the unit circle: T. H. Gronwall.

Some theorems on transformations with invariant points: J. W. Alexander.

Theorem on the interior of a simply connected closed surface in three-space: J. W. Alexander.

A fundamental class of geodesics on closed surfaces of genus greater than unity: H. M. Morse.

On the problem of steering an automobile around a corner: A. G. Webster.

On the principles of mechanical integrators for differential equations, especially those of exterior ballistics: A. G. Webster.

On the Fourier's series of non-integrable functions: C. N. Moore.

A generalization of Laguerre's rule of signs: C. F. Gummer.

The functions analogous to Lebesgue constants for a series of Hermite polynomials: R. E. Gilman.

Theory of invariant elements: O. E. Glenn.

On the location of the roots of the jacobian of two binary forms: J. L. Walsh.

The power of a modern gun and of thunder: J. E. Rowe.

Spurious correlation applied to urn schemata: J. R. Musselman.

The significance of the partial correlation coefficient in the comparison of ordered statistical series possessing rectilinear trends: W. L. Crum.

A tentative substitute for the standard deviation in the examination of the dispersion of an ordered statistical series: W. L. Crum.

The value of a sample. Second paper: B. H. Camp.

A form of series for potential problems: Norbert Wiener.

Some hydrodynamic aspects of group theory: S. D. Zeldin.

Two-way series for Lebesgue integrals: M. B. Porter.

R. G. D. Richardson,
Secretary

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THE ENGINEER; HUMAN AND SUPERIOR DIRECTION OF POWER[1]

The forces of nature are the most enduring wealth of mankind. To know their laws and to learn how to apply them has made of a puny little being of about 130 to 200 pounds of flesh and bone—three fourths of which is merely water—a giant of which Gulliver's tales have no equal; and compared to which the largest and most muscular animals of present or former geological periods are merely drowsy, clumsy creatures. All this has been accomplished by his few grams of better brain-matter, which permitted him to gather scientific knowledge and thus to wield powers akin to those attributed to some of the gods of antiquity.

But the forces of nature, in wrong hands, can be diverted from their very highest purposes into the basest demoniacal utilization.

During the late war, one of the nations reputed for its scientific knowledge, staggered history by the wholesale, unscrupulous utilization of science and engineering in attempting to extend and perpetuate an anachronistic and domineering system of government. The other nations, in trying to withstand this onslaught upon right and decency, were in their turn compelled to enlist the talent of scientists and engineers alongside the efforts of soldiers and sailors.

And now, thank God, we chemists can turn again to the sphere of action where we truly belong. We can try anew to become apostles of construction instead of destruction; soldiers of progress, of peace and happiness.

Unfortunately, this does not mean to say that *all* which *all* chemists accomplish is *always* dictated by such lofty motives; no more than liter-

[1] Address presented at the joint meeting of the American Chemical Society and the Society of Chemical Industry (of Great Britain), New York, September, 1921.

ature, or art, or religion is never debased by low aims.

Whatever else this war has brought forth, it has at last taught the ignorant multitude that, in our modern complex civilization, chemists are as indispensable as engineers, notwithstanding the fact that the lawyer-politician still holds the floor.

Nor should the public be blamed too much. The work and purposes of the chemist are not easy to understand to the average man or woman, too often devoid of even rudimentary scientific knowledge, although in some cases they are the bearers of a college degree earned by a one-sided exclusively literary education.

What appears even less obvious, even to the better informed classes, is the relation of the chemist to the chemical engineer. It is less known that a man may be a scientific star of the first magnitude and yet be incapable of utilizing his science in the industries, or of applying it in the many other ramifications of the economics of our civilization—not to speak of the recent applications of science in war. It does not seem obvious to many that there is the same difference between a good grammarian or philologist and a successful writer, be the latter a novelist, an essayist, a journalist or a playwright; that a learned botanist will not necessarily make a successful farmer, no more than a mathematician will surely prove a good accountant, nor a good accountant an able business man, nor a philosopher a successful statesman.

In the same way, explorers frequently make unsuccessful settlers. The true scientist is an explorer in the broadest sense of the word. He explores the laws of nature. By direct observation or experiment, and aided by theoretical reasoning, he tries to correlate the observed facts until he believes that he is warranted to generalize thereon. He thus helps to discover new truths or laws of nature. These, in their turn will permit him to predict facts in advance until further observations or experiments either support him or point out that his generalizations or theories were based on insufficient research or faulty interpretation of the recorded data. Whenever this occurs, he is compelled to turn back on his steps and gather additional knowledge and try better theories. Thus are the methods of science and research. But before any such laboriously gathered knowledge can be utilized, there is a vast amount of further methodic work to be performed.

After a geologist has revealed and surveyed a body of ore in the mountain, the mining engineer and the metallurgist know very well that this does not necessarily mean a paying mine, or a successful smelting works.

So it is in chemistry. The experience of many a scientist has been confined exclusively to laboratory work, or to purely chemical subjects. This is frequently the reason of his weakness in dealing with practical matters, when he is inclined to concentrate his point of view too much on only a part of the subject with which he is confronted. He is apt to neglect other considerations which although seemingly unimposing from a scientific standpoint, frequently carry with them the very elements of success or failure in practical applications.

When, during the war, the problem came up to start the manufacture of optical glass for gunsights and other instruments used in our army or navy, it was easy enough to take care of the chemical side of this subject after raw materials of sufficient purity had been obtained and as long as the glass was produced merely in quantities of a few ounces where the mass could readily be melted in platinum crucibles. But when it came to produce tons of homogeneous optical glass for real wholesale use, then the most tantalizing problem resided in the proper construction and handling of large clay crucibles; this for the simple fact that the molten glass dissolved the clay of the pots and got spoiled by taking up impurities, in the same way as water would dissolve a container made of sugar or of dried mud.

Many a chemical reaction brilliantly successful in the laboratory as long as the operation could be limited to small quantities and carried out in glass, porcelain or platinum vessels, has been doomed to failure when attempts were made to run it on a permanent commercial scale. It needs quite some experience and a good deal of common sense to know when it is

cheaper to simply burn up sawdust waste instead of trying to distill it or convert it into paper pulp, and to know when it is cheaper, for this purpose, to buy expensive wood in the shape of clear logs. It requires quite an effort of good judgment to know when it is less ruinous to burn waste flax straw from our linseed fields than to try to spin or weave it; to know when it is less injurious to one's bank account to leave natural soda and potash salts in lake water instead of obtaining them by the usual processes. That Boston clergyman of about twenty years ago may have had correct chemical information when he started that company for extracting the limitless tons of gold naturally contained in sea water, but if he had been just a little of a chemical engineer, he might readily have concluded that it was cheaper to leave all that gold in the ocean than to try to extract it by methods which cost more than the value of the gold.

Then again, there are cases where even the best of chemists committed errors of judgment and failed to solve problems because they lacked the daring of the engineer.

Sir Humphry Davy, one of the greatest chemists of his age, showed his lack of qualifications as a chemical engineer when he reported unfavorably on the project to use coal gas for the illumination of the City of London. One of his most emphatic objections was that it would require a gas holder as large as St. Paul's Church dome, and even after this was constructed, it would blow up at the first opportunity.

As an opposite example, I should cite the great Belgian engineer, Solvay, who revolutionized the manufacture of soda, one of the chemicals most indispensable to civilization and used in enormous quantities. His success was mainly due to the fact that he was more of an engineer than a chemist. In developing his process, he was unaware that this reaction was not new; that it was so old and so well known that several patents on this very subject were already on record and that, furthermore, the process had been tried commercially about half a dozen times in several countries, and had invariably been unsuccessful. Fortunately, all this discouraging information reached him only after his keen engineering talent had already demonstrated that this elusive chemical process could be controlled in the hands of an engineer and made to operate so successfully as to throw in the scrap heap the older processes used until then.

The pure chemist, confined by the walls of his classroom, his laboratory, or his library, sometimes fails to exercise sufficiently the sense of proportion.

Nor are the engineers, as a class, free from being carried away by a one-sided point of view, although their way of reasoning and grappling a problem is more along quantitative considerations.

The ways of thinking and acting of a chemist and that of an engineer are often along decidedly different points of view. Yet, if these points of view can be compromised, or harmonized, they bring forth good chemical engineering. Nor is this always an easy task. Too often I have seen cases where the engineer, regardless of well-established chemical facts of which he was conveniently ignorant, diligently went on designing the most elaborate and ingenious equipment, giving minute attention to every structural and mechanical detail, and then handed plans and specifications to the chemist to leave the "chemical details" of the problem to the latter. These "details" consisted in specifying a material about as strong as steel, resisting strong acids or other very corrosive agencies, extreme heat, and which should, furthermore, be furnished at a price about that of steel or bronze. When the chemist meekly answered that he knew of no material that would answer the purpose except platinum, iridium, or possibly gold, the information was received with a look of contemptuous disappointment on the part of the engineer.

In another case, a laboratory chemist had been carrying out a chemical process where he heated corrosive liquids under high pressure in sealed hard glass tubes of about half an inch in diameter. In the meantime, he hoped that any engineer forthwith would build him an apparatus with which to perform the same operation in ton lots.

Simple as it sounds, it requires quite some experience, quite some common sense before the chemical engineer knows when to specify stoneware instead of lead, or other metals, or *vice versa,* or to learn how to alter the design of an equipment so as to make it adaptable for each of these different structural materials. I well remember the look of disgust of an engineer who had drawn his specifications of heavy stoneware to within one sixteenth inch of margin, to find out when the apparatus was finally delivered, at the end of several months drying, and baking and waiting, that the dimensions had warped several inches and did not fit with the other parts of the equipment. That very day he learned that it pays to order his stoneware a long time in advance and to wait for its delivery before adjusting the final designs of the adjacent equipment according to what he got from the pottery. I am glad to see that during the competition of the last few years, stoneware manufacturers have made much progress.

In another case, a chemical engineer made a success of a different problem of pumping a corrosive liquid where delicate pumps made of expensive alloys or stoneware were most of the time out of order, until he superseded them by home-made pumps made of cast iron or cement. They corroded very fast, but their construction and replacement were so simple and inexpensive that he could afford to replace them rapidly with much less trouble or cost.

In many chemical industries, after once the initial chemical problems have been overcome, the manufacturing problems resolve themselves to cost of operation and mass production. No wonder then that in such industries the engineer's problems seem to dwarf those of the chemist to such an extent that sometimes the manufacturers seem to be astounded when one reminds them that after all their enterprise is essentially chemical. This is of little consequence in so-called "prosperous" times, when orders are abundant, profits considerable, and when the main problem is one of output. In times of keener competition the unchemically trained directors of such enterprises are sometimes unpleasantly reminded that they need clever chemists as well as good engineers and business men and that, while they were asleep on this subject, their keener competitors have been improving their industries along chemical lines.

Steelmakers or smelters, for instance, are apt to forget that metallurgy is, after all, a very chemical industry where most of the great strides were made through chemical considerations. The same can be said of sugar, glass and soap manufacturing.

To the wide-awake manufacturer, the present industrial depression should be an incentive to engage more chemists, to do more chemical research work, instead of laying off the men of their chemical staff, as has happened in too many instances since we got out of that fool's paradise of so-called "prosperity."

Most of our industries badly need "fertilizing" and fertilizing is better done while the land lies fallow than during planting or harvesting time.

Whenever I see such shortsightedness which is bound to stunt our industrial efficiency for the future, then I wonder whether some of the financial or business men at the head of large industrial enterprises are not occupying their position on an assumed and unearned reputation.

Some of our industries are more particularly adapted to our country on account of an exceptionally abundant supply of the raw materials they employ; this gives them at once a distinct advantage over other countries which have to import these raw products. But precisely in some of these industries, the chemical point of view has been much neglected, except in minor details.

For instance, we have that enormous industry of petroleum refining. Ever since petroleum was first discovered, the processes of rectification have not varied much from the general methods of fractional distillation by which different compounds are separated by order of volatility in light hydrocarbons of the gasoline type, somewhat higher boiling liquids of the kerosene type, then lubricating oils, vaseline or petroleum jelly, and the least volatile and hardest of all, paraffine.

It is true that in this general process of dis-

tillation, improvements have been introduced from time to time. For instance, the intermediate treatment with sulphuric acid, then later the destructive distillation at higher temperatures or the so-called "cracking" processes which break up the more complex hydrocarbon molecules of the heavier distilling liquids and thereby increase the yield of the lighter and more valuable gasoline.

Nevertheless, the fact remains that aside from a relatively small proportion of lubricants, the bulk of raw or refined petroleum is burnt as a fuel. This burning may be done directly in oil burning furnaces, or as refined kerosene in our lamps, or as gas from our gas works, or by a much more efficient way, in our internal combustion motors, varying from the smallest motorcycle engine to the heaviest Diesel generators.

There was a time when coal also was exclusively used as a fuel until the chemists succeeded in converting one of its least attractive by-products, coal-tar, into a series of the most startling syntheses, which opened an entirely new field in chemistry. These coal-tar derivatives include not only an endless variety of dyes, but the many other valuable synthetic substances used in the art of healing and sanitation, as well as the newer synthetic resinous products which have opened new possibilities in electrical insulation and numerous other industries, and the chemicals which are used in the art of photography. Nor should I omit to mention the new explosives obtained from the same source, and which are safer and easier to handle than dynamite or gunpowder, and which find greater and more lasting applications in mining, agriculture and engineering than in war. Agents of foreign interests had long ago started a propaganda campaign among our teachers of chemistry as well as among our congressmen and manufacturers, making them believe that the United States was not suited for this industry of coal-tar products, and that Germany could better supply us. But the war awakened us from our torpor when we were confronted by the fact that the coal-tar derivatives were the indispensable key to many of our most important industries and that the war could not be won without them, and that Germany had lulled us into inaction until, in experience, we were a full generation behind her. By supreme efforts, our chemists and business men overcame this fearful handicap; this achievement remains one of the most brilliant pages of our national history. And now it looks as if shortsightedness and politics were about to destroy what has been raised after so much effort.

But let us return to the subject of the petroleum industry: The abundant existence of this raw material, as well as natural gas, in America is mainly due to the special geological history of this continent. Geological changes here have been less violent, less metamorphic than in Europe or most other countries, so that the geological deposits or stores of these rather fugitive materials have been less disturbed, less broken up by subsequent upheavals.

Especially in natural gas do we possess a raw material which almost exclusively belongs to this country. When we reflect, however, that this raw material cannot readily be transported, we should seek methods to convert it into other commodities which lend themselves to easier transportation.

If we have acted as spendthrifts with our coal and petroleum, we have behaved as barbarians with our natural gas resources until there is little left of it. Yet natural gas contains valuable substances which under the hand of the chemist may be used as a starting point for syntheses perhaps more valuable than what has been accomplished with coal-tar. While the period of brutal waste is not yet ended, the dawn of a more enlightened utilization seems to be in sight. I learned recently that at least one of our more progressive and better organized industrial enterprises has undertaken the problem of more methodical use of natural gas along scientific and chemical lines. From the results already obtained, there is good hope that some day our natural gas resources may provide us with new synthetic products which may open entirely new possibilities in various other industries. I should add that the company in question, notwithstanding the present business depression, has not discharged its research chemists. On the contrary it has recently added

considerably to its research staff and equipment, although endeavoring to cut unnecessary expenses in other directions.

Industrial alcohol is another chemical industry in the United States which seems susceptible of an incomparably wider development as soon as it is less hampered by fanaticism in a more efficient commercial production and easier distribution. The ignorant multitude does not class alcohol as a chemical industry. Most people can not see in alcohol anything but its use or abuse as a beverage.

And yet, outside of such uses, there is hardly a chemical susceptible of wider and more beneficial application in the arts, the industries and the household economics. Its value as a solvent, its use in varnishes, artificial leather, smokeless powder, is well known among chemists. But a much more extended use is possible as a liquid fuel. The fact that it is far less volatile than gasoline and mixes readily with water, makes it not only cleaner, but incomparably less dangerous, whether it be used in the household for heating or illuminating purposes, or whether it be used on a motor car or a motorboat, or stationary engine.

Furthermore, its sources of supply embrace all inexpensive starch- or sugar-containing vegetables, as well as the waste of our sugar refineries, all products of which this country has a prodigious supply.

Converting our perishable farm products into products like alcohol, which can be stored indefinitely and of which the transportation and handling are easy, is one of the ways of equalizing the uncertain fluctuations of the yield of our crops.

Long after every drop of petroleum or gasoline will have been extracted from our wells, every yearly agricultural crop will insure us a new supply of this valuable liquid fuel obtained by fermentation of starch- or sugar-containing liquids. I know of no country where there is such an abundant source of supply, as well as the industrial opportunities in conjunction with an extensive market within easy reach, provided industrial alcohol can be furnished to the consumer at a low enough price.

But unintelligent application of the Prohibition Act will offset all this, whatever good effects it may try to accomplish in other directions, by putting unnecessarily exaggerated restrictions or handicaps upon the manufacture or distribution of industrial alcohol.

Few people realize that the price at which alcohol can be delivered to the consumer at a profit is considerably influenced by whatever unnecessary red tape impedes manufacture, transportation or distribution. The well-intentioned manufacturer who is endeavoring to lower the cost of production, feels his efforts rather futile when they are wiped out at the selling and distributing end.

There is opportunity for considerable improvement in the technical end of this industry in the United States. In this respect, France and Germany were able to furnish better and cheaper alcohol than we were, because in those countries the industrial alcohol situation has always been more considered on its own merits. So has it come to pass that this branch of chemistry or chemical engineering has attracted fewer of our better scientists or engineers in the United States than in other countries. Justly or unjustly, this whole industry has been under the ban of social prejudice on the part of people who, in their zeal, can not discern between the drink evil and an indispensable chemical industry.

Yet, no less a man than the great Pasteur counts among the many illustrious chemists, biochemists and engineers, who have contributed to the development of the alcohol industry. It was Pasteur, while he was professor of chemistry at the University of Lille, who by undertaking to correct irregularities in the fermentation processes of a local distiller, discovered the fundamental truths relating to the phenomena of fermentation. Under his genius, the knowledge gained thereby became the starting point not only of radical improvements in the manufacture of fermentation processes, but they brought forth a veritable revolution in sanitation, surgery, and medicine. All this has sowed broadcast inestimable benefits on mankind, and has made the name of Pasteur sacred to every one who is not too ignorant to

know something about what he has done for humanity.

If every annual crop of starch- or sugar-containing plants can furnish us an abundance of liquid fuel and solvents under the form of alcohol, we may look at this from another point of view and call it simply the stored-up energy of the sun. The photochemical action of the sun rays under the influence of the chlorophyl, or green matter of the plant leaves, brings about the most subtle creative chemical synthesis. Carbon dioxide, a product of combustion, one of the ultimate destruction products of plant or animal life, combines with water under the action of sunlight. Dead matter reenters the process of life. The first, or one of the first products of this synthesis is formaldehyde; the latter, in its turn, inaugurates a succession of further chemical syntheses which result in the formation of sugars, starch, cellulose, and other carbohydrates. No sun, no photochemical synthesis, no crops—no life! So that, after all, the whole living world is dependent upon a delicate photochemical reaction. Starvation, on one hand, or abundance of crops and foodstuffs, on the other, all within the range of photochemistry.

In the same way, our vast coal beds and our petroleum wells and our natural gas, are merely the result of light energy stored up from the plant or animal life of former geological periods. This, in itself, ought to impress us with the enormous possibilities of photochemical synthesis. And yet, here is a field where the scientist or engineer has accomplished next to nothing. In the utilization of this marvelous energy, we have not gone much beyond the art of making photographs.

So here is a power, an energy, which has been much neglected by scientist and engineer alike. Where is the Faraday, the Ampère, the Leonardo da Vinci, where is the Archimedes who shall show us how to use the sun rays for charging our electrical storage batteries, or who will teach us how to handle the photochemical action of sunlight, or to emulate nature in her synthesis of plant life? Who will utilize this delicate method instead of our hitherto brutal processes of synthesis. Nature in her methods of plant life synthesis does not treat with boiling solutions of alkalies or strong acids; she uses no high temperatures nor strong electric currents. If we want to be successful in this direction, we shall have to utilize equipment possessing large exposed surfaces similar to the leaves of plants. We may have to operate in rather dilute solutions instead of the concentrations which are ordinarily used in our present methods. We may have to find means for rapidly separating the formed products as fast as they accumulate. We may be compelled to work within narrow ranges of temperature, perhaps not exceeding those outside of which plant life stops.

But who knows what surprises are in store for us and how we may simplify all this after the subject once begins to receive enough attention.

In the past, scientists have taught the engineers how to transmute the forces of nature, but this took a very long time. About a century and a half ago, Lavoisier, by his memorable work in chemistry, got as far as to exclaim: " In Nature nothing is created, nothing is lost, there are only transformations." But he was thinking of *matter* as such. It took almost a century more before Mayer and Joule proclaimed the same truth in physics as far as forces of Nature or energy are concerned. Our present conception of the conservation and transformation of energy are of rather recent date. Nor were these fundamental truths readily accepted without opposition. Since then, progress has been rapid. Scientists and inventors alike have taught the engineer how to transmute the forces of Nature.

Let us take, for instance, a well-known chemical reaction—the oxidation of carbon and hydrogen; whether this oxidation be accomplished simply by the burning of coal, gas, or oil in furnaces under a steam boiler, or by the internal combustion in any variety of a gas engine, it gives heat which in turn is transformed into motion or motive power, which runs our factories, our ships, our trains, our automobiles, our flying machines. Or, inversely, motion can be turned into an equivalent amount of heat by friction or otherwise, as

every one knows who ever operated an air compressor or had to deal with a badly lubricated axle.

But motion, whether it be furnished by water rushing from a waterfall, or by a steam or gas engine, or by a windmill, can be made to turn a dynamo and produce electrical energy. The latter, in turn, can be changed into motion, heat or light. Or again, we can bridge directly that jump between a chemical reaction and light by simply burning oil, gas, acetylene, or magnesium, and thus produce any range of even the most intense light. Or, in other cases, we use heat or electricity to decompose the most refractory substances in their elements, and some of our largest electro chemical industries in Niagara Falls are based on this. Or we may use either one of these forms of energy in chemical reactions which build up; which, in other words, bring about chemical synthesis.

But when it comes to transforming light energy into chemical synthesis, we have left thus far the monopoly of this agent to Nature; we have been acting as Rip Van Winkles.

In the museum of the Franklin Institute in Philadelphia exists an electrical machine which was used by Benjamin Franklin for his experiments. It was one of the very best electric machines of his day. Yet, at that time, it was a mere clumsy toy. When the weather was not too damp and all other conditions were propitious, the operator, after turning that glass globe until he was red in the face, could draw some insignificant sparks, or charge a Leyden jar, or give a harmless shock to the person who touched it. All this was not so very long ago. Yet that toy was the forerunner of our enormous electrical industries, and all the astounding modern applications of electrical energy; our electric generating stations which give us light, power and transportation, which move our trains, our ships, our factories, which generate power far beyond anything which unscientific man of antiquity, or of a few years ago, was able to dream of. That same electricity which gave us wireless telegraphy and the wireless telephone; which has made the world bigger, and, at the same time, smaller, by rendering every nook and corner more accessible.

Let those who at present lay off their research chemists, their physicists, their research engineers, remember that the tremendous gap between that toy electric machine of Franklin and the present electrical industry, would never have been bridged but for research, invention and good engineering.

L. H. Baekeland

Columbia University

HERBERT HAVILAND FIELD

On April 5 there died in Zurich, Switzerland, from heart failure following influenza, one to whom science and especially zoology owes a great debt. Herbert Haviland Field was not only a man of marked ability and personal charm but he also possessed unusual breadth of vision as well as the power to make his visions realities. By virtue of these traits he made contributions of fundamental and permanent value to the progress of science though he was known to relatively few because of his modesty and self-elimination.

Born in Brooklyn, N. Y., April 25, 1868, of Quaker ancestry which included some of the prominent citizens of that municipality a century ago, young Field had his early education in that city, was graduated from the Brooklyn Polytechnic and went to Harvard. There he took his bachelor's degree in 1888 and kept on until he had won his M.A. in 1890 and his Ph.D. in 1891. His doctor's thesis, a masterful study of the early development of the urogenital organs in Amphibia, gave him at once a high place in the esteem of workers in zoology.

On going to Europe in the following year, he met a cordial reception at the Universities of Freiburg in Baden, Leipzig, and Paris, at each of which he was given the doctor's degree. Even at the start of his studies he was impressed with the failure of investigators to give due attention to the work of the past and recognized that this neglect was due in large part to the lack of means for obtaining an adequate record of the volumi-

nous and widely scattered literature. As he studied this problem in various countries, the need grew upon him and the thought he had, even in student days, of some agency to handle the material in broad and comprehensive fashion took form gradually in the great Concilium Bibliographicum which he conceived, founded, and organized, an enterprise which testifies eloquently to his successful efforts for the advancement of science and the assistance of his coworkers in biology.

Dr. Field was a fine-looking man. Of large size and good figure, with dignified bearing, he attracted attention in any group even though in later years he had manifested a tendency to increase in weight which was, in fact, a trait inherited from his father. Two physical defects are worthy of note. He suffered from a constantly recurring migraine of great intensity. In the early days his friends and associates noted a marked tendency to stammer which became painful at times when he was involved in a vigorous argument. He studied the situation intensively to rid himself of the defect and it did largely disappear. It was, however, striking to those who had noted this peculiarity, to find that his conversation in other languages was entirely free from the difficulty. He spoke withal in an easy, flowing style which was vivid and sparkling, commanding the attention of the listener and carrying conviction to those with whom he was conversing.

His gift of tongues was indeed extraordinary, for in his college days he utilized Latin, German, French, Italian, Dutch, and Russian with apparently equal ease, and he is said to have been accustomed to write his diary in the last-named language. When the seventh International Zoological Congress met in this country it held a session at Cold Spring Harbor, and the delegates were received at Sagamore Hill by then President Roosevelt. At that time Dr. Field, who had known most of them for years, was called upon to introduce the foreign delegates to the President. He conversed readily with those whom he did not know, addressing each in his own language and telling Mr. Roosevelt about them. His exceptional memory was conspicuous to every one who came into contact with him, but most of all, perhaps, to those of us who were his associates day after day in the laboratory at the Museum of Comparative Zoology. He would not only repeat paragraph after paragraph from various lectures but would dazzle us by a record of scientific facts from papers and references to out-of-way publications with a completeness and precision that were remarkable in fields outside of the particular territory in which he was doing his own work. I have been told that his musical memory was even more remarkable. It is said that he would listen to a symphony concert and on returning home would play on any sort of a musical instrument not only the motif and its numerous variations but also whole sections of the composition even though he had just heard it for the first time.

Combined with this fine endowment of a precise and retentive memory was a sense of order and system that was equally conspicuous because of its contrast with the habits of the ordinary man. He was fond of system and had remarkable power for outlining and installing a plan, to organize any given material; this was coupled with unusual power in following out the system and applying it in detail to complex series of data. It must be confessed that in his own work he was not always so systematic. In the laboratory at the Agassiz Museum he worked with the greatest pertinacity and concentration, often not even stopping for lunch. But after some days of such effort, he might absent himself for two or three days at a stretch and would be found visiting or reading at home with equal intensity. Furthermore, he sometimes manifested that absent-mindedness, which some attribute to genius and which affects the little things of everyday life that seem of importance to a smaller man. He would lose one object or another and, after failing to find the thing for which he was looking, would exclaim: "Never mind! I think I left it on the train," or somewhere

else, and go on with the main object of life at that time with absolute unconcern. In this, he manifested the calm that may rightly be regarded as an inheritance from his Quaker ancestry, and that undoubtedly carried him through many difficult and awkward situations with an unruffled mind. His exactitude of action was labelled by some as a tendency to procrastinate for he would always turn up just at the moment when a train was leaving or was even already in motion. Such precise punctuality resulted in unfortunate failure sometimes when circumstances beyond his control resulted in minor delays on the way.

His dogged determination is well illustrated by a comment made in personal correspondence from Dr. C. B. Davenport, who was an intimate friend of Field's and to whom I am indebted for great assistance in preparing this sketch. Dr. Davenport writes:

> An exceedingly valuable trait was his pertinacity. I have occasion to remember that, having put my hand to the plow of civil engineering, I was loathe to turn back; but Field had set his heart on my coming to Harvard and he was irresistible. I owe my entrance into biology as a profession to him. This pertinacity showed itself in the way he upheld the Concilium through many dark years and declined alluring invitations to continue his work elsewhere under more favorable auspices. None of these suggestions or appeals seemed to make any impression on him, if they involved a relinquishment of his well-thought-out plans.

Field's greatest work, and the one for which he will always be remembered and through which science has incurred to him an obligation that never can be discharged, was, of course, the Concilium Bibliographicum. To it he devoted his energies with intensity and rare persistence in the face of apparently insurmountable difficulties. Indeed, it would not be in the least an exaggeration to say that the load, which he had been carrying, especially in these months since the end of the war when it seemed as if the project might be put upon a permanent basis, even though it met opposition in some quarters and indifference in others, laid a tremendous burden upon his shoulders. In fact, his intimates had noticed for some months conspicuously that he was overworked even though they had not suspected the collapse which came so suddenly.

While a graduate student at Harvard under the leadership of Professor E. L. Mark, Field became deeply impressed with the need for the systematic rearrangement of the scientific publications where, in the field of zoology, a multitude of articles in hundreds of scattered periodicals were unknown even by title to the workers in the field and could be brought together only at an entirely unreasonable outlay of time and energy. It was computed at one time that there appeared annually upwards of ten thousand notes and articles, distributed through at least fifteen hundred periodicals in different languages. The unsystematic condition of the literature and the delays he saw in work repeated and in time and energy wasted in hunting out the records of the student's predecessors in order that the investigator might start at least on a level with those who had gone before, provoked in his mind the insistent inquiry as to the means for the improvement of the situation and the elimination of this waste. I think there is no doubt that he was stimulated also by the general development of systematic bibliography in the United States. He planned to reorganize the field of zoology and related sciences and to apply the decimal system of classification, then recently developed and published by Dewey. Furthermore he felt that the arrangement of records of the literature in book form fell short of the best plan available, and he proposed to substitute for it an analytical card catalogue through which every new publication would naturally and promptly drop into its proper place, and the student thus be able in a moment's time to gather together all of the publications on a given topic instead of hunting for them through volume after volume of an annual catalogue. Every zoologist is familiar with the splendid way in which this idea was developed and the unparalleled success with which the literature of the subject was indexed, for the Concilium cards have

included a much larger percentage of references in the literature of zoology than has ever been brought together by any other agency. Furthermore, this record has been furnished with a promptness that stands in striking contrast with the leisurely appearance of other bibliographic information. With the rapidly growing literature in this field, it was inevitable that the catalogue, especially in its full form with special cross references, began to assume considerable size, and some critics failed to recognize in this the true condition—the inevitable advancement of a growing field—and commented on the space required as if it were a defect of the system employed.

I recall vividly hearing Field on one occasion respond to such a comment by saying that despite its increase, the catalogue would not in a century reach the dimensions necessary to house a mounted elephant and yet no museum would hesitate to devote much more than that space to the representation of that single species. Field was not only the first to develop these ideas in a practical way, but he assumed the even greater burden of converting the unbelievers and the indifferent, and of securing adequate moral and financial support for the project. He visited the leaders in this country and abroad, secured the unqualified and enthusiastic endorsement of such men as Dohrn in Naples, Carus in Leipsic, Arnold Lang in Zurich, and, especially, of the French zoologists. In connection with the Institut International de Bibliographie in Brussels, he undertook to carry out part of the plan to utilize the Dewey system in the entire range of bibliography, until in the Third International Zoological Congress in Leyden at the instigation of the delegate of the Société Zoologique de France approval and support were enthusiastically pledged to the foundation of the Concilium Bibliographicum to be located at Zurich under his directorship. Subventions were given it officially by Switzerland, the canton and city of Zurich, and by several European governmental and institutional agencies, so that finally in the fall of 1895, Field took up his residence in Zurich and officially opened the work of the Concilium. An American can not view with any large degree of pride the attitude of this country towards the enterprise. While it was receiving vigorous official and personal support in Europe and Field was himself devoting all of his time and a very considerable amount from moderate means to its maintenance, financial cooperation was unfortunately exceedingly limited here. It was a cause of constant regret to Field as his friends knew by his personal communications that so rich and generous a country, which he was always proud to claim as his own, had contributed in such a meager degree to an international enterprise, organized and led by one of its own citizens.

At first, Field was the entire Concilium. He did all its work, cared for its interests, sought out and developed its support, and carried its burdens. Gradually it grew despite indifference and opposition until it had its own printing press and staff of expert workers. Zoologists were forced to recognize the efficiency of the organization and the success of its work. The indomitable energy of its leader, his supreme confidence in its value, and his ability to present its claims in clear and convincing fashion, overcame every obstacle, and year by year it grew to be more extensive and more indispensable until, finally, the war broke. Then all such enterprises were thrown aside and the activities of the Concilium were temporarily suspended. It is worthy of mention that during this period, Field turned with equal energy and devotion to the solution of the problems that presented themselves in the social world and performed important services for his native country and for the mountain republic in which he had found his home. With the close of the war, however, he went back with the greatest eagerness to the work of the Concilium, and in 1920, made a visit to the United States for the purpose of arousing again the interest in the project and securing the necessary financial support. Encouraged by his reception, he returned to Switzerland confident that a new era of opportunity

for himself and the Concilium had opened. But though his sudden and unexpected death has taken him away from this work, no one can believe that men of science will be so lacking in foresight and so blind to their own interests that the great work which he did and the institution which he founded will be permitted to perish.

Field displayed constantly a deep devotion to principles and while easy to work with and ready to yield where the matter in question was only a difference of opinion, he stood like a rock when what he regarded as fundamental issues were at stake. When the project of preparing a general bibiography of science was developed by the Royal Society of London, backed with large subsidies and immense prestige through its official governmental affiliations, the directorship was offered to Field through Sir Michael Foster. It was, however, set as a condicio sine qua non that the decimal system of notation should be abandoned in favor of another employing Latin titles. After careful consideration, Field felt that this was a step backward and would introduce confusion. Consequently, he declined the post despite its alluring features. It is interesting to note that despite the immense resources at the disposal of the Royal Society it never published an annual bibliography anything like as complete as that issued by the Concilium and the references came regularly also a year late. So determined was the opposition to his project, however, that pressure was brought upon universities abroad to bring them to cancel subscriptions to the Concilium, and representations were even made to the Smithsonian Institution and to private foundations in this country that the Royal Society regarded it as an unfriendly act to extend help to the Zurich enterprise. In England, Manchester University protested against this attitude and with characteristic independence the *Manchester Guardian* came out in vigorous defense of the Concilium. In this country, Professors Henry Fairfield Osborn, E. L. Mark, C. B. Davenport, and G. H. Parker were vigorous in their defense of the methods and results of the work done by the Concilium. The American Association for the Advancement of Science made for many years a contribution to the work of the Concilium which, despite the doubts of some members, was taken from the research fund at the urgent request of a large body of working zoologists who asserted emphatically that this institution and its work were the most valuable single adjunct to investigation at the command of the American investigator.

His work won recognition for Field from many sources. He was honorary assistant of the Museum of Comparative Zoology at Cambridge, Mass., trustee of the International Institute of Bibliography at Brussels, Belgium, editor of the Bibliographia Zoologica, fellow of the American Association for the Advancement of Science, and had been elected to honorary membership in a long list of prominent scientific societies.

He was married in 1903 in London to Nina Eschwege, who with their four children is still living in Zurich. Two brothers and a sister are residents of Brooklyn.

Few men have devoted themselves so incessantly and unselfishly to the service of others. If he had withdrawn in his own laboratory and had concentrated on his individual researches his unusual mental endowment would unquestionably have produced conspicuous results. He chose rather to devote himself to the improvement of conditions for his fellow workers. He threw himself into this work with all the powers at his command and what he accomplished has been of inestimable service to a multitude of workers.

Henry B. Ward
University of Illinois

SCIENTIFIC EVENTS

WINTHROP ELLSWORTH STONE

The Associate Alumni of the Massachusetts Agricultural College through their executive committee has adopted the following minute:

Winthrop Ellsworth Stone, an honored member of the class of 1882 of the Massachusetts Agricultural College and since 1900 President of Pur-

due University, lost his life while scaling Mount Eon, a virgin peak in the Canadian Rockies, July 17, 1921.

The Associate Alumni of the Massachusetts Agricultural College, through its executive committee, desire to express and record their appreciation of the fruitful service which Dr. Stone has rendered to education, chemical science and scientific agriculture.

With natural abilities of a high order, he brought to his work scientific training obtained as an undergraduate and graduate student at this college under the guidance of Goessmann, Clark and Stockbridge, as plant pathologist at the noted Valentine Farm, New York, and as a student at the University of Göttingen, where he took his doctorate with Tollens and Victor Meyer. Returning to America in 1888, he became chemist to the Tennessee Experiment Station, a year later accepting a call to the chair of chemistry at Purdue University. It was during this period that he made his principal investigations in the field of agricultural chemistry. After serving for a time as vice-president, he succeeded Dr. Smart as president on the retirement of the latter in 1900. Under his wise and able administration Purdue has attained a leading position among the educational institutions of the country.

He was a lover of manly sports, especially of mountain climbing, the favorite recreation of his later years, and one in which he achieved notable distinction by his ascents of difficult peaks.

Modest and unassuming, yet resolute and resourceful, of unflinching courage, zealous for truth and inspired by lofty ideals, as an educator he stands preeminent among the sons of the college. He will be remembered with high regard, pride and affection by those whose lives were enriched by his friendship, and as one who shed luster on his alma mater.

MORTALITY STATISTICS FOR 1920

The Department of Commerce announces that the Census Bureau's annual report on mortality statistics, which will be issued shortly, shows 1,142,578 deaths as having occurred in 1920 within the death registration area of continental United States, representing a death rate of 13.1 per 1,000 population as compared with 12.9 in 1919, which was the lowest rate recorded in any year since the registration area was established in 1900.

The death registration area (exclusive of the Territory of Hawaii) in 1920 comprised 34 states, the District of Columbia and 16 registration cities in nonregistration states, with a total estimated population on July 1 of 87,486,713, or 82.2 per cent. of the estimated population of the United States. The state of Nebraska was added to the registration area in 1920, so that at present the only states not in the area are Alabama, Arizona, Arkansas, Georgia, Idaho, Iowa, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, West Virginia, and Wyoming. The figures for the territory of Hawaii will appear in the report, but they are not included in this summary.

The death rate from pneumonia increased from 123.5 per 100,000 in 1919 to 137.3 in 1920. For chronic diseases of the heart the rate increased from 131.0 to 141.9; for cancer, from 80.5 to 83. Some of the other diseases for which the rate increased are whooping cough, measles, cerebral hemorrhage, congenital debility and malformations, puerperal fever, scarlet fever and appendicitis. The fatalities caused by automobile accidents and injuries show an increase from 9.4 per 100,000 in 1919 to 10.4 in 1920.

A marked decrease is shown in the death rate from tuberculosis, which was 114.2 in 1920 as compared with 125.6 in 1919; also in the death rate from influenza, 71.0 in 1920 as against 98.8 the year before. The death rate from suicide declined from 11.4 in 1919 to 10.2 in 1920. There was a decline also in the rate for typhoid fever and in that for accidental drowning.

THE MOUNT EVEREST EXPEDITION

The British Mount Everest Committee has communicated to the London *Times* the following telegram, dated October 10, at Phari Dzong, from Colonel Howard Bury:

The route to the summit of Mount Everest by the northeast arête has been found to be practicable.

On September 22, six members of the expedition, with 26 coolies, arrived at the col at the head of the Kharta valley, camping at 22,500 feet.

On the following day, Mallory, Bullock and

Wheeler encamped on the glacier below the north col.

On the 24th they ascended the north col, connecting Everest with the north peak, to 23,000 ft., finding the northeast arête quite possible, but they were driven back by a furious northwesterly gale, lasting four days, with intense cold, and making all climbing impossible.

All the party are in good health. The reconaissance of Mount Everest is now completed.

The *Times* writes:

The expedition started from Darjeeling on May 18 and 19, and, taking its way through the switchback mountains of Sikkim, entered Tibet and then made westward to Tingri Dzong—north-northwest of Everest, which place was made the base for the exploration of the north and northwestern faces of the mountain. The utmost care had been taken in the fitting out of the expedition, but transport difficulties soon developed, for the mules supplied by the Indian Government broke down completely. Fortunately, Colonel Howard Bury was able to supply this deficiency locally.

The work of exploring the northwest approaches to Everest began on June 23, and on July 3 Messrs. Mallory and Bullock succeeding in climbing a peak over 23,000 ft. high. But means of ascent of Everest itself on this side proved utterly lacking—terrible precipices, descending 10,000 ft. on to a huge glacier, blocked the way. Even supposing that the rock summits at 20,000 ft. were gained—which seemed just possible—hard rock-climbing for the remaining 4,000 ft. was out of the question at that altitude.

As the north and west approaches had proved impracticable, camp was moved up Kharta at the end of July, and August devoted to reconnoitering the east side of the mountain. Here, again, disappointment awaited the climbers, for, as on the north and northwest, the eastern approaches were found to be guarded by huge precipices.

As a last resort the climbers then determined to follow up the Kharta-Tsangpo, a glacier stream, to its source, and it is in this direction that success has at length been obtained. A reconaissance early in August had shown the climbers a hitherto unknown valley which seemed to offer a practical route, and they reached a col nearly 23,000 ft. up looking on to the north ridge of Everest. The weather, however, had broken, and the climbers had to return to Kharta for a rest. They left Kharta again on August 31, and the telegram received to-day from Colonel Howard Bury tells of the happy ending to their endeavours.

Apart from this discovery of a way up the mountain, over 9,000 square miles of new territory have been surveyed.

THE LABORATORY OF THE MIAMI AQUARIUM ASSOCIATION

Students of marine life and especially those interested in fishes will be gratified to know of the establishment of a seaside laboratory by the Miami Aquarium Association at Miami Beach, Florida. The laboratory occupies the second floor in the south wing of the aquarium building and has accommodations for about ten investigators. It is provided with running fresh and salt water, with the usual laboratory outfit, and with reagent and photographic rooms. Materials for study are abundantly supplied from the large stock of the aquarium and from the neighboring waters. The aquarium runs a fleet of collecting boats including gasoline launches and three sea-going vessels: the *Allisoni,* moved by sail and gasoline, provided with live wells, and adapted to cruises of several days' length; *L'Apache,* a seventy-foot cruiser; and the *Sea Horse,* an eighty-five-foot, high-power cruising yacht just put into commission. In this way collecting trips may be made to the shoals in Biscayne Bay, the reefs in the open ocean, the Gulf Stream three miles distant, and to the Florida Keys and the Bahamas.

During a sojourn at the laboratory from the latter part of last May till the middle of July a great variety of interesting forms were met with. *Physalia,* the Portuguese man-of-war, with its symbiotic fish *Nomeus,* was abundant in the shore waters. During the latter part of June it was actively reproducing. At the same time the large rhizostomous jelly-fish *Stomolophus* was to be seen in great numbers off the coast. On the bank in Biscayne Bay the spiny sea-urchin *Diadema* and the giant conch *Strombus* were common. Spiny lobsters were always obtainable in great numbers. During July the eggs of the loggerhead turtle were hatching and sets of these were brought into the laboratory and studied there. But above all the region is immensely rich in the great variety of its highly colored, tropical fishes.

These include the various kinds of angel-fishes, parrot-fishes, snappers, trunk-fishes, morays, barracudas, sea-horses, etc., and are most beautifully exhibited in the tanks of the aquarium. But much remains to be done in ascertaining what is available in the local fauna, and the director of the aquarium has already taken steps to carry out a preliminary biological survey of the region about Miami.

The aquarium is situated on the bay side of Miami Beach at the east end of the new causeway connecting the beach with the city of Miami. A line of electric cars crosses the causeway and makes the run in either direction in about twenty minutes. Hence a person working at the laboratory may reside either in Miami, the fourth largest city in Florida, or at Miami Beach, where sleeping apartments and bungalows may be had and where there are ample restaurant accommodations. Those who want particular information about the laboratory should apply to the director, Mr. L. L. Mowbray, Miami Aquarium, Miami Beach, Florida.

G. H. Parker

Harvard University

THE TORONTO MEETING OF THE AMERICAN SOCIETY OF ZOOLOGISTS

The executive committee of the American Society of Zoologists has decided to present at the meeting of the society at Toronto, Canada, December 28–30, 1921, a symposium program on the general subject of "Orthogenesis," broadly interpreted, the object being to bring into the discussion as many of the newer aspects from the varied fields of the natural and physical sciences as may be feasible. The speakers the committee have invited to address the society and the subjects of each speaker are as follows; several are still in the tentative stage, as indicated:

Professor L. J. Henderson, Harvard University, "Orthogenesis from the standpoint of the biochemist;" speaker to suggest an opener for the discussion. The speaker who has been invited is at present abroad.

Professor C. B. Lipman, University of California, "Orthogenesis in bacteria;" speaker to suggest an opener for the discussion.

Professor M. F. Guyer, University of Wisconsin, "Orthogenesis in serological reactions."

Professor Wm. Bateson, of England, discussion by Dr. O. C. Riddle, Cold Spring Harbor, Long Island, New York. Title not yet received.

Professor W. M. Wheeler, Harvard University, "Orthogenesis in ants;" discussion by Professor H. C. Crampton, Barnard College, New York City.

Professor H. F. Osborn, Columbia University, New York City, "Orthogenesis as observed from paleontological evidence beginning in the year 1889;" discussion by Dr. J. C. Merriam, Carnegie Institution.

Charles A. Kofoid,
President

SCIENTIFIC NOTES AND NEWS

The autumn meeting of the National Academy of Sciences will be held at the University of Chicago on November 14 and 15.

The thirty-ninth stated meeting of the American Ornithologists' Union will convene in Philadelphia, at the Academy of Natural Sciences, from November 8 to 10.

The Berzelius medal has been conferred on Professor E. Abderhalden, director of the physiological institute of the University of Halle, for his research on the defensive ferments and in other lines of biologic chemistry.

Mr. A. Crommelin, assistant astronomer of the Royal Observatory at Greenwich, has been awarded the Ponthecoulant Prize of the Paris Academy of Sciences in recognition of his general astronomical work.

President Harding has appointed Dr. John Glover South, of Frankfort, former president of the Kentucky State Medical Association, as minister to Panama.

James A. Crawford left his position with the Buffalo Botanic Gardens on October 1 to accept an appointment as assistant curator at the New York Botanical Garden.

George M. Rommel, now chief of the division of animal husbandry of the Bureau of Animal Industry, United States Department of Agriculture, became editor-in-chief of the publications of the American International Publishers of New York, beginning on November 1. These include *The Field Illustrated;*

System on the Farm; El Campo Internacional, and *The Field Year Book.*

Mr. Alfred Chaston Chapman, F.R.S., president of the Institute of Chemistry of Great Britain and Ireland, has been appointed a member of the British Royal Commission on Awards to Inventors, in the room of Sir James Johnston Dobbie, D.Sc., F.R.S., resigned.

It is announced that the Colonial Office of Great Britian is organizing an expedition for research on the serotherapy of sleeping sickness in Africa. The research is to include both men and animals, and plans for a two years' stay. The expedition is in charge of Drs. Marshall and Bassolo of the Uganda Public Health Service, with two assistant physicians and two veterinarians.

The University of Toronto through its deparment of biology is developing a plan for the systematic study of the inland waters of Ontario. The work will be chiefly economic in outlook and will be under the supervision of Professor B. A. Bensley. A field party in charge of Professor W. A. Clemens spent the past summer on Lake Nipigon.

Dr. R. P. Hibbard, associate professor of plant physiology at the Michigan Agricultural College and plant physiologist at the Michigan Agricultural Experiment Station, has been granted leave of absence for the current year in order to accept a Johnston scholarship in the Johns Hopkins University. He is engaged in research in the laboratory of plant physiology.

The first meeting for the session 1921–1922 of the Chicago Institute of Medicine was held October 21, when the Pasteur lecture was delivered by Dr. Theobald Smith on "Theories of Susceptibility and Resistance in Relation to Methods of Artificial Immunity."

Dr. René Ledoux Lebard, of Paris, addressed the historical section of the New York Academy of Medicine on October 13. The subject of his paper was "Color Print Illustration of Medical Books up to the Year 1800."

Sir Harold J. Stiles, of Edinburgh, delivered the Wesley M. Carpenter Lecture before the New York Academy of Medicine on the evening of October 20. His subject was "Surgical Tuberculosis in Children and Its Relation to the Milk Problem." On October 14 he delivered a Mayo Foundation lecture, "The history of medicine in Edinburgh."

Professor Charles Baskerville, of the College of the City of New York, lectured on "Science and Civilization; the Rôle of Chemistry," at the joint meeting of the Technical Societies and the Rhode Island Section of the American Chemical Society, at Providence on October 18.

Sir W. J. Pope, president of the British Society of Chemical Industry, lectured before the Congress of Industrial Chemistry recently held in Paris on the future of organic chemistry, with special reference to the advantages which France and Britain might derive from their tropical possessions. Sir William Pope spoke at the annual dinner of the British Society of Chemical Industry when he referred to the recent visit of delegates of the society to Canada and the United States.

Nature states that Charles Darwin's birthplace, known as The Mount, Shrewsbury, situated in that part of the town known as Frankwell, has been purchased by H. M. Office of Works. The house was built about 1800, and at the time when Sir Francis Darwin wrote, in 1887, "The Life and Letters of Charles Darwin," it had undergone but little alteration. It was "a large, plain, square, red-brick house, of which the most attractive feature" was "the pretty greenhouse, opening out of the morning-room."

Professor Alexander Gray, director of the school of electrical engineering at Cornell University, died at his home in Ithaca on October 13.

The death is announced of Dr. M. H. Fussell, professor of applied therapeutics in the University of Pennsylvania and a member of the committee on revision of the U. S. Pharmacopeial Convention.

The death is announced of Emile Houzé, professor of anthropology at the University of Brussels and at the École d'Anthropologie of that city.

We regret to record the death of Seymour C. Loomis, Esq., who while practicing law at New Haven long served the American Association for the Advancement of Science as secretary of the section of social and economic sciences.

The 111th regular meeting of the American Physical Society will be held in Chicago, at the Ryerson Physical Laboratory, on Saturday, November 26. If the length of the program requires it, there will also be sessions on Friday, November 25. Other meetings for the current season are as follows: December 27–31, Toronto: annual meeting. February 25, New York. April 22, Washington.

A public meeting under the auspices of the New York sections of the four national engineering societies on the subject of "the St. Lawrence Ship Canal and Power Project" will be held in New York City on November 14.

The annual meeting of the American Philosophical Association will be held on December 28, 29, and 30, at Vassar College, Poughkeepsie, N. Y. The meeting will open with an informal smoker on Wednesday evening. On Thursday morning and afternoon and Friday morning the sessions will be devoted to the reading and discussion of papers. The annual dinner, followed by the address of the president, will be held on Thursday evening.

We learn from *Nature* that the number of ordinary scientific meetings of the London Chemical Society to be held during the coming year has been increased with the object of affording greater facilities for papers to be read before the society. The first meeting was held at Burlington House on October 6. Following the custom of the last few years, the council has again arranged for the delivery during the session of three special lectures which, by the courtesy of the council of the Institution of Mechanical Engineers, will be held in the lecture-hall of that institution. The first, entitled "The genesis of ores," will be delivered by Professor J. W. Gregory on December 8. On February 9, Sir Ernest Rutherford will lecture on "Artificial disintegration of elements"; while the last lecture, by Dr. H. H. Dale, entitled "Chemical and physiological properties," will be given on June 8.

The *Journal* of the American Medical Association reports that an appropriation of $16,000,000 for the construction of additional hospital facilities to provide medical, surgical and hospital services for former service men is contained in a bill introduced by Representative Langley of Kentucky, chairman of the House Committee on Public Buildings and Grounds. The money is supplementary to the $18,500,000 appropriated at the last session of Congress, the total of which has already been disbursed with the exception of $1,339,000. In the new Langley measure $15,500,000 will be used for hospitals and extensions to present facilities to be distributed under the supervision of the Secretary of the Treasury. The other $500,000 carried by the bill will be assigned to the purchase of additional land and for the erection of new buildings at the Mount Alto institution. Representative Langley presented his bill after extensive conferences with representatives of the Treasury Department and with officials of the American Legion.

The prevalence of foot and mouth disease in some countries in Europe, in certain parts of Asia and Africa, as well as in South America, has caused the United States Department of Agriculture to institute special quarantines against the importation of live stock from these places. Any one who wishes to import cattle, sheep, goats, swine or other animals from any country, except Canada or Mexico, must first obtain from the Secretary of Agriculture a permit, to be presented to the American consul at the port from which the animals will be shipped. No permits are issued for shipment from countries where rinderpest, surra, foot and mouth disease, or contagious pleuro-pneumonia exist. Foot and mouth disease prevailed to a serious extent in England during the last two years, but recently has been abated to the extent that horses from both England and Ireland

are now allowed to enter the United States if certain restrictions regarding feeding and care are observed.

The 158th meeting of the Washington Academy of Sciences was held at the Public Library, October 20. The meeting was devoted to a discussion of popular and readable books in science. After informal talks by Dr. G. F. Bowerman, librarian of the Public Library, and by several members of the committee appointed to select the list of "one hundred popular books in science," an opportunity was given to examine the books themselves and to discuss them informally. In addition to the selected list of 100, there was a second exhibit consisting of books suggested for the popular list, but not used, and the members of the committee were invited to criticize their choice and suggest substitutions or additions, in order that the best possible list might be prepared for distribution by the librarian. A third exhibit consists of readable manuals or information-books which workers in one branch of science can recommend to workers in other branches or to readers seeking general information on a given subject. Suggestions as to improvements and additions to this list were also invited.

The department of botany of the State College of Washington has increased its herbarium by the acquisition of the recent collections of Mr. James R. Anderson, the veteran Canadian botanist of Victoria, B. C. His herbarium comprises 2,600 mounted sheets of the higher plants, coming from all over British Columbia. The majority of the specimens are from Vancouver Island, but there are also considerable numbers from the humid coastal strip of the mainland, others from the dry belt east of the Cascades, and others from the high Rockies.

The Iowa Child-Welfare Research Station at the State University has organized a Laboratory in Child Psychology for experimental work with children from two to four years of age. A new four-room building has been constructed, and 24 children are now in attendance daily, in two sections from 9 to 12 o'clock. The laboratory is under the immediate direction of Dr. Bird T. Baldwin, research professor in psychology, and Dr. Lorle I. Stecher, research assistant professor, with graduate student assistants.

The Polish National Museum of Natural History has been formed by a union of the Branicki Zoological Museum and the Zoological Museum of the University of Warsaw.

The New York Zoological Park has made a presentation of a number of reptiles to replace those in the Jardin des Plantes, Paris, which had to be destroyed during the war. The gift includes two boa constrictors, six alligators, and sixteen turtles.

A prize of £20,000 is being offered by the French Aeronautic Propaganda Committee to the constructor of a motor for commercial aviation which shall best satisfy the tests of a special competition, including durability, regularity and simplicity.

A special faculty research committee has been organized at Oberlin College to cooperate with the "National Research Council." Dr. S. R. Williams, head of the department of physics, is chairman, while other members of the committee include members of the departments of mathematics, sociology, psychology, chemistry and geology.

Dr. Wm. Curtis Farabee, president of the American Anthropological Association, has returned to his work at the University of Pennsylvania. During the summer he attended the Centennial Celebration at Lima, Peru, as one of the special mission appointed by President Harding. The Lima Scientific Society held a special meeting in Dr. Farabee's honor and elected him a corresponding member. All members of the Mission were elected to the ancient order "El Sol de Peru." The commission, composed of the Honorable Albert Douglas, General Hunter Liggett, Admiral Hugh Rodman, Colonel Wm. Boyce Thompson, Honorable Wm. Heimke and Dr. Wm. Curtis Farabee, sailed from New York on three U. S. battleships, the *Arizona, Oklahoma* and *Nevada,* under command of Admiral John McDonald.

Mr. George D. Hubbard, professor of geology at Oberlin College, has returned from a

year of travel and study in the Hawaiian Islands, Japan, Korea and China. He spoke at the government colleges for teachers in Peking, and at other schools in China. The report of his work, which is the most detailed study made to date, of the valley of the Min river in the borderland of Thibet, some 300 miles beyond Cheng Tu, will be published by the government geological survey of China. Mr. Hubbard is also preparing papers on the copper mines near Cheng Tu worked by the Chinese, on the antimony mines at Kwang Tung, near Canton, on the physiographic history of the Yang Tse river, and on the geography of some of the Chinese rivers. The copper mines at Asieo, Japan, will be the subject of a paper. Mr. Hubbard is planning two books based on the year's study; a book on the development of the mineral resources of China, and a book on the geography of China for use in Chinese schools.

UNIVERSITY AND EDUCATIONAL NEWS

DEAN HENRY P. TALBOT, of the department of chemistry of the Massachusetts Institute of Technology, and Dr. William H. Nichols, of New York, made addresses at the dedication of the new Steele Chemistry Building at Dartmouth College, on October 29.

PROFESSOR ARTHUR M. GREENE, JR., head of the mechanical engineering department at Rensselear Polytechnic Institute, at Troy, N. Y., has been appointed dean of the School of Engineering of Princeton University.

PROFESSOR A. V. MILLER, associate professor of drawing and descriptive geometry, has been appointed assistant dean of the college of engineering of the University of Wisconsin to take the place of Professor J. D. Phillips who is now acting business manager of the university.

AT the Detroit College of Medicine and Surgery Dr. Donald Beaver, formerly of the pathologic department of the University of Minnesota has been appointed assistant professor of pathology, Dr. Paul Wooley, former professor of pathology in the University of Cincinnati, associate professor of pathology and pathologist to the Herman Keiffer Hospital, Detroit.

DR. SERGIUS MORGULIS has been appointed professor of bio-chemistry and Dr. George A. Talbert assistant professor of physiology in the College of Medicine, University of Nebraska, Omaha.

DR. M. J. DORSEY, for ten years in charge of the section of fruit breeding of the department of horticulture of the University of Minnesota, has been elected head of the department of horticulture of the West Virginia University and the West Virginia Agricultural Experiment Station, to succeed Professor J. H. Gourley.

HENRY SCHMITZ AND C. EDWARD BEHRE, of the school of forestry, University of Idaho, have been advanced, respectively, to the rank of associate professors of forest products and of lumbering.

DISCUSSION AND CORRESPONDENCE

AERIAL OBSERVATION OF PHYSIOGRAPHIC FEATURES

THE article on "Aerial observation of earthquake rifts" published by Professor Bailey Willis in SCIENCE for September 23, 1921, prompts me to add a word to his interesting discussion. During the war I had occasion to make a short aeroplane flight over the harbor of Valona for the purpose of studying the natural topographic defenses of that strategic key to the southern Adriatic Sea. The ascent was made in the late afternoon, when strong shadows brought out most distinctly the relief of the terrain. It was to me a matter of some surprise to find that physiographic features which were so poorly represented on the inadequate maps of the region as scarcely to betray their presence, or at least their true character, appeared with surprising distinctness when seen from the plane. In particular, certain abandoned shorelines, now left some distance inland by the prograding of the shore, and which I had failed to observe in brief excursions by automobile about the harbor, suddenly stood out with all the clearness of a diagram. The es-

sential characteristics of the mountain ranges of this part of Albania were much more easily observable than from the ground, while something could also be determined about the form of the seaward extension of the land under the shallow marginal waters of the Adriatic, especially as to the submarine extension of delta and beach deposits.

In an aeroplane flight from Paris to London this past summer I was again impressed with the potential value of the aeroplane in physiographic reconnaissance. The surface of northern France is of very moderate relief, yet when flying low it was much easier to observe many critical features and to note their broader relationships than would have been the case from selected points on the ground. The excellent topographic maps of this region render aerial observation less necessary than in countries where maps are poor in quality, or wholly lacking; but there can be no doubt of the value of such observation in supplementing map studies and ordinary field work on the ground. On both the French and English shores of the English Channel shoreline phenomena such as cliffs, beaches, dunes, deltas, and submarine bars not only were remarkably distinct, but their relations to surrounding features appeared with a clearness observable in no other manner. Certainly the large scale British maps of the Dungeness foreland, excellent as they are, give no such vivid impression of the evolution of that wonderful series of beach ridges as comes to one who looks down on the foreland from an aeroplane flying at an altitude of a few thousand feet. In the late afternoon the unroofed dome of the Weald had all the distinctness of a relief model, with the oval pattern of its infacing cuestas or hogbacks readily distinguishable.

In the detailed work of tracing specific peneplane levels across mountainous country one not infrequently encounters the difficulty that in critical areas where observations are much needed the only effective viewpoints are rendered useless by a dense forest cover; or one may climb a selected peak only to find that it is not at the proper elevation to give the best results. Good field observations may be of vital importance, not merely as a check on profile studies based on topographic maps, but also because the limitations of the profile method are such that not infrequently proper field observation alone can settle doubtful points. It has occurred to me that in studies of this nature either the captive balloon or aeroplane could be used to good effect. Map studies, where possible, will define the limits of the problems to be settled in the field, and indicate the places where evidence of decisive value can most probably be secured by satisfactory observations. A few hours in captive balloon or aeroplane under these conditions might prove of more value than weeks of inconclusive work on the ground.

Douglas Johnson

Columbia University

SCIENTIFIC LITERATURE IN EUROPEAN COUNTRIES

The lead taken by the Biological Club of the University of Minnesota should certainly be followed by many other scientific groups or individuals, according to their ability. Such arrangements as Dr. Barker describes not only promote the interests of science, but also aid materially in bringing about that international good-will and cooperation which this world so sorely needs. After a visit to Europe one returns with the conviction that if the psychological difficulties could be overcome, it would not take very long to restore material prosperity. Could Europe somehow be endowed with a genuinely scientific spirit, combined with general good will, the fearful situation which now exists might well give way to a new epoch compared with which the past would seem like a bad dream.

During the winter I was in Portugal and the Madeira Islands, I found that the escudo, formerly having the value of a dollar, was rapidly diminishing in exchange value. On arriving in Madeira in December, I got 28 for an English pound. When I left, in March, the exchange was fluctuating between 45 and 50 to the pound. I met a very able and enthusiastic

naturalist in Funchal, who was handicapped at every turn by the lack of literature. He had purchased what he could, but at present prices were prohibitive. The Madeira Islands are extraordinarily interesting to the biologist, and every encouragement should be given to those who would study the fauna, flora or geology. Why should not we place a good series of American publications in the public library (Biblioteca Municipal) of Funchal, where they would be available to students? Anything sent there, care of the librarian, Sign. A. C. de Noronha, will be appreciated. There is, however, another very important way in which we can render assistance. That is by subscribing to European scientific journals, or joining scientific societies. In doing this, we enrich ourselves. The gallant way to which the scientific home fires have been kept burning in certain quarters would command our admiration if we knew the facts. Take for instance the *Annals and Magazine of Natural History,* the leading zoological journal of England. It appeared regularly all through the war, though the staff of the printing office (Taylor and Francis) was reduced to a minimum. It publishes zoological papers more promptly and accurately than any journal in America. Not long ago I presented a paper on fossil insects, with over 50 figures, and it appeared within a few months. I was not asked to pay for the cuts, as one often is in America, sometimes at fancy prices. The obvious comment would be, that the Annals must be a prosperous concern, quite unlike our poor American journals. On the contrary, I happen to know that it is losing heavily, but it carries on. There are many such cases, I do not doubt.

T. D. A. Cockerell

University of Colorado

SCIENTIFIC BOOKS

Sturtevant's Notes on Edible Plants. Edited by U. P. Hedrick. Report of the New York Agricultural Experiment Station for the year 1919, II. Albany, J. B. Lyon Co., State Printers, 1919. 4to. Pp. i–vii, 1–686, with portrait.

A work of more than usual note has been made available to students of agricultural botany by the publication of a selected portion of the data on edible plants brought together by Dr. E. L. Sturtevant, first director of the New York Agricultural Experiment Station. Over six hundred quarto pages comprise the body of the volume, to which are added bibliography, index, biographical sketch of Dr. Sturtevant by Dr. Hedrick, editor's preface, Director W. H. Jordan's letter of transmittal, and a full-page portrait. The entries are arranged alphabetically under the Latin name of the plant to which reference is made. The first entry is here reproduced to give an idea of the manner in which the material is presented.

Aberia caffra Harv. & Sond. *Bixineae.* Kai Apple. Kau Apple. Kei Apple.

South Africa. The fruits are of a golden-yellow color, about the size of a small apple. They are used by the natives for making a preserve and are so exceedingly acid when fresh that the Dutch settlers prepare them for their tables, as a pickle, without vinegar. Jackson, J. R., *Treas. Bot.* 2: 1255. 1876.

The closing citation is not attached to the paragraph as shown here, but is dropped to the bottom of the page, taking the form of a footnote. When mention of a synonym is required it follows the citation at the bottom of the page. Many of the entries are only of a few lines each, some of them range up to a page or two, while about two dozen entries occupy more space. About three pages each are given to Lima bean, English bean, pea, egg plant, cucumber, watermelon, kale, parsley, and wheat; four pages each to artichoke, carrot, onion, and radish; five pages each to banana, currant, cabbage, turnip, tomato and muskmelon; six pages each to beet, common or field bean, potato and pepper; eight pages to strawberry; and twelve pages to squash and pumpkin, and to corn. To secure the data, Dr. Sturtevant, who had a good reading acquaintance with Latin, Greek, French and German, and some knowledge of other languages, accumulated an extensive library, especially rich in pre-Linnaean works, and abounding in rare issues.

The underlying idea of the work is to supply data on the history of edible plants whether accounted of little or much value, and especially regarding their early uses in all parts of the world by primitive peoples and others, and to trace their introduction into cultivation, and their expansion into varieties as known at the present time. In these respects he has greatly added to the knowledge available in DeCandolle's "Origin of Cultivated Plants," Pickering's "Chronological History of Plants," and other standard works on the history of esculents.

The wealth of material brought together may to some extent be judged from the fact that DeCandolle's work, generally considered the best available on the history of cultivated plants, treats scarcely of 250 kinds, while the present work embraces nearly 3,000 kinds. The work is, moreover, only the choicest part of a vast storehouse of information secured by Dr. Sturtevant, which he would undoubtedly have elaborated into a still more extensive work, had it not been for his premature death. The extent of the research involved, a specially valuable portion being the knowledge obtained from rare and obscure writings, can be inferred from there being upwards of 6,000 citations, referring to some 500 publications.

But the work is not simply that of a bibliophagist and collector of data, for Dr. Sturtevant was a life-long student of constancy and variation in both plants and animals. As joint proprietor with his brothers of Waushakum Farm and Director of the New York Agricultural Experiment Station he possessed great opportunities for direct observations, which his keen and richly endowed mind combined with energy and initiative utilized to fullest degree. This practical knowledge has insured the omission of improbable travellers' tales and fanciful myths, and made the entries as scientifically historical and accurate as is possible.

Large credit must be given for preparing and issuing this volume to the broad-visioned director of the station at Geneva, Dr. W. H. Jordan, who authorized its preparation, and to the editor, Dr. U. P. Hedrick, who has shown in the arrangement of its contents a fine knowledge of the subject, rich scholarship and unflagging zeal. It was necessary for Dr. Hedrick to select the material from a vast amount of manuscripts, notes, and card catalogue items that had lain in the station library for twenty years, and to verify and complete the long list of citations. He has also supplied a very full and sympathetic account of Dr. Sturtevant's scientific career. The writer of this notice was associated with Dr. Sturtevant during the larger part of his directorship, and can therefore more fully realize the extent and value of the original material and of the labor expended upon it by the editor.

J. C. Arthur

Purdue University,
Lafayette, Indiana

SPECIAL ARTICLES

THE DISPLACEMENT METHOD FOR OBTAINING THE SOIL SOLUTION [1]

There have been several methods proposed for obtaining the soil solution. Among the most promising of the methods are those which depend upon the principle of the displacement of the soil solution by another liquid. Schloesing[2] was probably the first to use the displacement method, using water as the displacing liquid. Istcherekov[3] used ethyl alcohol as the displacing liquid and obtained results indicating that the true soil solution was secured. Morgan[4] has modified the displacement method, using a heavy oil as the displacing liquid and applying pressure to force the oil into the packed soil.

The present investigation was suggested by the work of Istcherekov, and the procedure followed was essentially the same as used by that investigator. Several displacing liquids were tried, including those miscible and nonmiscible with water. The most satisfactory results were secured by use of ethyl alcohol.

The method consists of packing the moist

[1] Published with the permission of the Director of the Wisconsin Agricultural Experiment Station.

[2] *Compt. Rend. Acad Sci. Paris,* 63, 1007 (1866).

[3] *Jour. Exp. Landw.* (Russia), 8 (1907).

[4] Mich. Agr. Exp. Sta. Tech. Bul. 28 (1916).

soil in a cylinder provided with an outlet at the bottom. The ethyl alcohol is then poured on top of the soil column and as it penetrates the soil it displaces some of the soil solution which forms a zone of saturation below the alcohol. This zone increases in depth as it is continually forced downward by the alcohol. When the saturated zone reaches the bottom of the soil column the soil solution, free of alcohol, drops from the soil as gravitational water.

The only apparatus required is a cylinder in which to pack the soil. Brass soil tubes or glass percolators were used for this purpose. The diameter of the tube and the height of the soil column determine the rate and time required for displacement.

The soil was packed in the cylinders by means of a short wooden rod. No difficulty was experienced in obtaining uniform packing. The degree of packing required for the best results is determined by the kind of soil and its moisture content. Sands and peats can be packed very firmly, but with heavier soils care must be taken that they are not puddled in packing, in which case displacement is exceedingly slow or entirely prevented. To prevent puddling it is best to use the heavier soils at moisture contents slightly below their optimum for plant growth. After a little experience one can readily determine the proper degree of packing for any soil at a given moisture content.

The time required for displacement varies widely depending on the moisture content of the soil, the degree of packing, the soil type, and the height of the soil column. In most cases it is possible to complete the displacement in one day, often in a much shorter time, if the soil column is not over twelve to fifteen inches in height. However, in some cases it required several days to complete the displacement.

It is practicable to obtain 35 to 45 per cent. of the soil solution by this method. However, it is possible to displace a much larger percentage of the soil solution than this. Using a silt loam soil at a moisture content of 23.3 per cent. a 75.6 per cent. displacement has been secured. Istcherekov reports that with a soil at saturation it is possible to displace about 95 per cent. of the soil solution before the appearance of alcohol.

The method has been successfully used on a number of soils including sands, loams, clays and peats. The results obtained indicate that the true soil solution is secured. Successive portions of the displaced solution have the same composition as is indicated by total salt and freezing point determinations. It is probable that the solution obtained is a true aliquot of the entire soil solution, that is, the displaced solution is of the same composition as the portion remaining in the soil. A comparison was made of the amount of total salts and nitrates obtained by the displacement method and by a 1 : 5 water extraction of the soil. The results given in Table I. shows that the two methods give approximately the same amount of total salts. The results for nitrate nitrogen are the same within experimental error.

TABLE I

Total Salts and Nitrate Nitrogen in the Dry Soil as determined by the Two Methods

Kind of Soil	NO_3 P.P.M. Water Extract	Nitrogen Displacement	Total Salts P.P.M. Water Extract	Displacement
Clay loam	71.5	75.2	796	747
Clay	29.4	24.7	370	306
Sand	18.7	22.4	205	275
Sand	57.0	61.2	1,400	1,512
Silt loam	10.8	9.7	223	161
Silt loam	79.8	71.0	732	648
Silt loam	48.3	54.5	506	512

Although the displacement method has received only slight recognition, the writer believes it has many possibilities. It seems to offer an opportunity for a more careful study of the concentration, composition, and reaction of the soil solution. A more complete knowledge of the changes that take place in the soil solution should aid in the solution of many of the problems of the soil fertility, plant nutrition, and related subjects.

F. W. Parker
University of Wisconsin

THE AMERICAN ASTRONOMICAL SOCIETY

THE twenty-sixth meeting of the society was held from August 30 to September 1, 1921, at Wesleyan University, Middletown, Connecticut. The attendance was the largest in the history of the society, more than one hundred members and guests being present. The visitors were housed in the college dormitories and had meals in common in one of the fraternity houses. Among the social events were a reception at the Van Vleck Observatory by Dr. and Mrs. Frederick Slocum, tea at the home of President and Mrs. Shanklin, a motor ride, hike, and a boat trip on the Connecticut River.

The sessions on three days were taken up by the reading of papers and committee reports. The eclipse committee gave complete information in regard to possible sites for the total solar eclipse in Australia on September 21, 1922, and reported progress on investigating the conditions for the eclipse in lower California and Mexico on September 10, 1923. There is promise that opportunity will be taken at both of these eclipses to verify the Einstein effect which was first observed at the eclipse in 1919.

Twenty new members were elected to the society, bringing the total membership of the society up to 370. The society elected to honorary membership Professor C. W. L. Charlier of the University of Lund.

Officers for the ensuing year are as follows:

President—Frank Schlesinger.

Vice-presidents—Otto Klotz and John A. Miller.

Secretary—Joel Stebbins.

Treasurer—Benjamin Boss.

Councilors—Philip Fox, Caroline E. Furness, A. O. Leuschner, Henry Norris Russell, V. M. Slipher, Frederick Slocum.

In view of the increasing interest taken in the gatherings of the society, it was decided to have two meetings during the next year, the first to be held in Christmas week in 1921 at a place not yet determined.

The program of papers was as follows:

On the correlation of wave-length with spectral type and absolute magnitude: SEBASTIAN ALBRECHT.

The number and distribution of novæ: S. I. BAILEY.

New measures of solar activity and the earth-effect: LOUIS A. BAUER.

Notes on the early evolution of the reflector: LEWIS BELL.

On the real motions of the stars: BENJAMIN BOSS, HARRY RAYMOND, and RALPH E. WILSON.

The Trojan group of asteroids: ERNEST W. BROWN.

Peculiar spectra in the large Magellanic cloud: ANNIE J. CANNON.

Gilbert's bombardment hypothesis: JULIAN L. COOLIDGE.

The amplitude of the light-variation of δ Cephei: RALPH H. CURTISS.

The spectrum and radial velocity of Comet 1913 f (Delavan): RALPH H. CURTISS and DEAN B. MCLAUGHLIN.

The parallax of Nova Aquilae No. 3: ZACCHEUS DANIEL.

Spectroscopic measurements of the solar rotation in 1915: RALPH E. DE LURY and JEAN EDOUARD BELANGER.

Displacements of lines in spectra of spots situated at various distances from the center of the solar disc: RALPH E. DE LURY and J. L. O'CONNOR.

Dark nebulæ in the Orion and Sagittarius regions photographed with the 100-inch Hooker telescope: JOHN C. DUNCAN.

Note on the parallaxes of stars with large proper motion: F. W. DYSON.

The mass of Neptune: W. S. EICHELBERGER and ARTHUR NEWTON.

The probable absence of a measurable electric field in sun-spots: GEORGE E. HALE.

Mars 1920: GEORGE HALL HAMILTON.

The spectroscopic system of σ Scorpii: F. HENROTEAU.

Some remarks on Cepheid variables: FRANK C. JORDAN.

A remarkable meteor trail: FRANK C. JORDAN and KELVIN BURNS.

Approximate orbit and absolute dimensions of S Antliæ: ALFRED H. JOY.

Some recent results in photographic photometry: EDWARD S. KING.

Notes on observations of nebulæ: C. O. LAMPLAND.

A computation of the solar motion from the radial velocities, proper motions, and spectroscopically determined parallaxes of 762 stars: E. S. MANSON, JR.

The orbit of ζ Centauri. Preliminary note on υ Sagittarii: ANTONIA C. MAURY.

Progress in radial velocity observations of long-period variables: PAUL W. MERRILL.

Parallaxes of seventy-three stars: JOHN A. MILLER.

The new electric driving clock of the photographic telescope of the U. S. Naval Observatory: GEORGE HENRY PETERS.

Preliminary parallax of the Pleiades: JOHN H. PITMAN.

The intensity distribution in the solar spectrum: H. H. PLASKETT.

The spectroscopic orbit and dimensions of TV Cassiopeiæ: J. S. PLASKETT.

The radial velocities of 594 stars: J. S. PLASKETT, W. E. HARPER, R. K. YOUNG, and H. H. PLASKETT.

A probable influence of the earth on the formation of sun-spots: LUIS RODÉS.

The relation between the diameter of a photographic star image and its magnitude: FRANK E. ROSS.

Systematic corrections and weights of catalogs. An addition to Appendix III of Boss's Preliminary General Catalog: ARTHUR J. ROY.

Orbits of three spectroscopic binaries: R. F. SANFORD.

Phenomena in connection with our transit of the plane of Saturn's rings in 1920–1921: E. C. SLIPHER.

Further notes on spectrographic observations of nebulæ and clusters: V. M. SLIPHER.

Some recent results of plate tests at the Harvard Astronomical Laboratory: HARLAN TRUE STETSON.

The diurnal variation of clock rates: R. H. TUCKER.

The Elgin Observatory: FRANK D. URIE.

Progress in the chronographic registration of radio time signals: FRANK D. URIE.

The San Diego Radio Time Signals: FRANK D. URIE.

Internal motion in four spiral nebulæ: ADRIAAN VAN MAANEN.

Atomic structure: FRANK W. VERY.

Solar hot-box studies: FRANK W. VERY.

Observations of 12 Lacertæ, 1919, 1920, 1921: R. K. YOUNG.

Orbit of the spectroscopic binary Boss 5442: R. K. YOUNG.

JOEL STEBBINS,
Secretary

NEW YORK MEETING OF THE AMERICAN CHEMICAL SOCIETY

DIVISION OF BIOLOGICAL CHEMISTRY

Arthur W. Dox, *Chairman.*
Howard B. Lewis, *Secretary.*

Symposium on Vitamines

The antineuritic vitamine: CASIMIR FUNK.

Experiments on the isolation of crystalline antineuritic vitamine: ATHERTON SEIDELL.

The antiscorbutic vitamine: A. F. HESS.

Factors influencing the vitamine content of food materials: R. ADAMS DUTCHER.

Standardized methods for the study of vitamines: A. D. EMMETT. In view of the great stress that is being placed upon vitamines with respect to the etiology of certain deficiency diseases and to the relative content of various products and foods, it would seem almost imperative to follow a more definite method of procedure than is now used in carrying out the biological tests. Otherwise, it is quite conceivable, due to the many possible variables that may easily enter, that the results obtained by the workers from different laboratories may be contradictory or even misleading at times.

It is suggested, as a step in correcting this condition of affairs, that it would be well to outline definitely and in detail the various stages of the procedure so that there can be provisional methods to refer to as standards. If these are established and followed, they will serve as a guide from and to which it will be possible to correlate the results obtained when the animal diets or rations are varied in accord with the needs of the individual projects and make it easier to conclude with more definiteness the significance of the results.

Standardized methods for the study of vitamines: A. D. EMMETT.

Vitamines from the standpoint of structural chemistry: R. R. WILLIAMS.

Vitamines from the standpoint of physical chemistry: V. K. LA MER.

General Discussion—KATHERINE BLUNT, G. H. A. COWLES, and others.

The influence of the vitamine content of a feed on the nutritive value of the milk produced: J. S. HUGHES, J. B. FITCH, and H. W. CAVE. Four calves were started on the experiment; two were from cows which had received a food low in vitamine during the entire gestation period, the other two were from cows which had received normal feed. During the first week the two calves from the experimental cows received their mothers' milk. At this time one of these cows died and her calf was then given the other experimental cow's milk. The two calves from the cows receiving normal feed were fed on herd milk exclusively. All four calves wore muzzles so they could get no other feed. All the calves seemed to be normal for the first five weeks, at which time one of the calves receiving the

experimental milk became blind. It died when it was forty-two days old, showing nervous symptoms very much like an animal with beri beri. The other experimental calf became blind when seventy-eight days old and died nineteen days later with symptoms like the first. A calf from a cow receiving normal feed was placed on the experimental milk at the time the first calf died. It did not become blind but died at the end of nineteen weeks. The two calves receiving the herd milk are still normal after a period of eight weeks.

The influence of excessive oxidation upon the nutritive and antiscorbutic properties of cow's milk: R. Adams Dutcher and Clifton W. Ackerson. Eight guinea pigs, used as controls, were fed a diet of oats ad libitum and 30 c.c. (daily) of fresh raw milk from the university dairy herd. Ten guinea pigs were fed oats and milk powder (prepared from the herd milk). The milk powder was diluted back to the same composition as the original raw milk and 30 c.c. were fed daily to each animal. The milk powder was prepared at intervals of 2 to 5 days by spraying the milk into a blast of hot air in a cell four feet square. Each quart of milk came in contact with approximately 1,400 cubic feet of hot air. The air in the cell was kept at a temperature of 115° C. while the temperature at the spray nozzle never exceeded 100° C. The milk powder was allowed to remain on the floor of the cell during the drying process (2–3 hours). No attempt was made to approximate commercial conditions. The entire group of guinea pigs receiving the milk powder died with pronounced scurvy lesions in periods ranging from 16 days to 42 days. At the end of 42 days all of the control animals, which had consumed their daily ration of raw milk, were living and in much better physical condition than the group receiving the dried milk.

The relation between the vitamine content of feed and hatchability of the eggs produced: J. S. Hughes, L. F. Payne, and F. E. Fox.

A comparison of the yeast and bacteria growth promoting vitamines: Louis Freedman. It was found experimentally that beef and beef-heart infusion, peptone and autolyzed yeast contain substances which are equally active for growth of hemolytic streptococci and yeast cells. This substance was found present to a limited extent, in casein and other animal and vegetable proteins which were specially prepared and purified. The substance active for streptococci is of similar nature if not identical with the yeast growth promoting vitamine present in autolyzed yeast. There is also present in beef heart another substance, associated with blood, which is necessary for growth of streptococci. The nature of this has not yet been determined. Further work on these problems is now in progress.

The vital problem of vitamines—a plea for a vitamine institute. Food products rich in vitamines: B. Dass. Since the indication of the existence of vitamines some twelve years ago, this subject has been receiving increasing attention. The results of many investigations have proved beyond doubt the utmost importance of the presence of vitamines in foods and also have established the relative vitamine content of the various articles of food. Nowadays there are in the market quite a few food products advertised to be rich in vitamines. The necessity of such products can not be overestimated provided they are truly rich in vitamines and at the same time reasonably low in price so as to be available to the poorer classes of people who are, generally speaking, the victims of diets deficient in vitamine-content.

The distributor of vitamines in natural foodstuffs: W. D. Richardson.

Some experiments with the vitamines of autolyzed brewer's yeast. Preliminary communication: Harry E. Dubin and Casimir Funk. Pigeon and rat experiments were conducted in order to test the influence of vitamine B and the substance (called provisionally "vitamine D") promoting the growth of yeast. The above vitamines were obtained, one practically free from the other, from autolyzed yeast by means of fractional shaking with fuller's earth. The results show clearly that pigeons require vitamine B while rats require vitamine D for maintenance and growth. On vitamine D alone, after one month, pigeons have not developed beriberi, although they have lost considerable weight. On vitamine B alone, rats have consistently lost weight and present a poor physical appearance. Both pigeons and rats thrive best on a mixture of vitamines B and D.

Proof of the presence of lipase in milk and a new method for the detection and estimation of the enzyme: Frank E. Rice and Alton L. Markley. (1) Lipases are defined as enzymes which split natural fats. (2) Methods for determining lipase are not satisfactory unless the fat-substrate is well emulsified in the suspension medium, and unless a preservative is used which prevents all bacterial

growth but does not check the action of the enzyme. (3) The following method is suggested: Boiled cream of high fat content is used as substrate. Cane sugar is added in sufficient quantity to form a saturated solution with all the water present. After addition of the enzyme, the mixture is titrated at the beginning and end of a digestion period. (4) It is proved that milk normally contains lipase. (5) Lipase doubtless is a factor in the development of rancidity in seed oils, butter and cheese. (6) Direct proof is offered that sweetened condensed milk becomes rancid on account of an admixture of raw milk, the lipase therein producing the phenomenon.

A quantitative method for the determination of peroxidase in milk: FRANK E. RICE, and T. HANZAWA. (1) The method of Bach and Chodat[1] is modified for application to milk. It depends upon the oxidation of pyrogallol to insoluble purpurogallein with hydrogen peroxide, the reaction being catalyzed by peroxidase. (2) The milligrams of purpurogallein obtained per 10 c.c. of milk is taken as the "peroxidase number." (3) Since several days are necessary for the attainment of equilibrium air must be excluded from the reaction. (4) The dependence of the peroxidase number on the amount of peroxidase present was proved by making determinations on various mixtures of raw and boiled milk.

Effects of certain antiseptics upon the activity of amylases: H. C. SHERMAN and MARGUERITE WAYMAN. The influence of toluene, formaldehyde and copper sulphate upon amylases of both animal and vegetable origin was studied. Toluene had very little influence upon the activities of the amylases either in their natural or purified condition. Formaldehyde even in small amounts (0.00006 molar and less) was found distinctly injurious to all of the amylases studied, viz., commercial pancreatin, purified pancreatic amylase, saliva, malt extract, purified malt amylase, commercial takadiastase, and the purified amylase of *Aspergillus oryzæ*. Takadiastase was the least, and purified pancreatic amylase was the most, affected. All of these enzymes were also found to be very sensitive to copper sulfate. The percentage loss of enzyme activity under the influence of formaldehyde or copper was determined by the concentration of the antiseptic in the solution and not by the ratio of antiseptic to enzyme or to substrate. The results as a whole, in addition to their bearing upon the problem of quantitative distinction between organized and unorganized ferment action, are of interest in that they afford a new indication of the protein nature of these typical enzymes.

[1] *Ber. d. d. Chem. Ges.*, 37 (1904), 1342.

The influence of certain amino acids upon the enzymic hydrolysis of starch: H. C. SHERMAN and FLORENCE WALKER. Addition of glycine, alanine, pheylalanine or tyrosine caused an undoubted increase in the rate of hydrolysis of starch by purified pancreatic amylase, commercial pancreatin, saliva, or purified malt amylase. Less marked results were obtained with the less sensitive enzyme materials malt extract, takadiastase, and an *Aspergillus* amylase product prepared in the laboratory from takadiastase. Each of the four amino acids here studied, as well as aspartic acid and asparagine previously reported, showed a similar favorable influence upon the enzymic hydrolysis of the starch. The addition of a mixture of two of these amino acids produced no greater effect than would result from the same concentration of one of them. In these experiments the favorable effect of the added amino acid was not due to any influence upon hydrogen-ion concentration nor to combination of the amino acid with the product of the enzymic reaction. On the other hand, it is shown that the addition of one of these amino acids is a very effective means of protecting the enzyme from the deleterious effect of copper sulfate and may even serve to restore to full activity an enzyme which has been partially inactivated by copper.

A study of the influence of arginine, histidine, tryptophane and cystine upon the hydrolysis of starch by purified pancreatic amylase: H. C. SHERMAN and MARY L. CALDWELL. Arginine, histidine, tryptophane and cystine were tested as to their influence upon the amyloclastic activity of a purified preparation of pancreatic amylase and it was found that arginine and cystine have a favorable influence, while histidine and tryptophane do not. Since the conditions of the experiments were carefully controlled and were uniformly favorable as to hydrogen-ion concentration and kinds and amounts of salts present, the differences in results are due to the specific effects of the individual amino acids. That histidine and tryptophane should have a different influence from all the other amino acids studied in this and the preceding investigations may be due either to their heterocyclic structure or to their position in the protein complex which doubtless constitutes either the enzyme molecule itself or an essential part of it, or to both. The influence of chemical structure of added substances upon their effects on enzyme action is being studied further.

Concerning the nature of the toxic products of Bacillus botulinus: J. Bronfenbrenner and M. J. Schlesinger. As a result of growth of *Bacillus botulinus* on appropriate medium rich in nitrogen, there can be demonstrated in the culture filtrate toxic products of two kinds. One is heat resistant, soluble in alcohol and acts without the incubation period. This toxic product consists of ammonia salts and is readily destroyed by the addition of strong alkali. The other possesses the properties of a true bacterial toxin. It is thermolabile, it acts only after a definite period of incubation, is not soluble in alcohol, has antigenic properties, and is neutralized by a specific antibody. This toxin is quite distinct from other bacterial toxins in that (in its crude state) it is poisonous when taken by mouth, in addition to being poisonous by injection, as is also the case with other bacterial toxins. When purified, however, this toxin loses its toxicity by mouth, while its activity by injection remains unimpaired. When the fraction removed by purification is reunited with the purified toxin, the mixture recovers its toxicity by mouth. In addition to the properties already mentioned, this toxin exhibits other characteristics unobserved in connection with other bacterial toxins. For example it is not digested by either pepsin or trypsin. By a proper adjustment of the hydrogen ion concentration it can be rendered as much as 10^{12} times more potent than other toxins. Unlike other toxins, it must be of a comparatively simple chemical composition, as its molecular weight is not more than 260 with only 3×10^{-23} gms. of total nitrogen in one lethal dose for a mouse of 18 gms. It appears to be the most potent substance ever described.

The internal factor in photosynthesis: H. A. Spoehr.

Comparative stability of alkylbarbituric acids as determined by availability of nitrogen for fungus cultures: A. W. Dox, Lester Yoder, and Adelia McCrea. One of the criteria of synthetic hypnotics appears to be chemical stability. In the barbituric acid series, hypnotic properties are confined to the 5, 5-dialkyl derivatives, the 5-monoalkyl derivatives being physiologically inert. This difference may be due to a difference in chemical stability, since the monoalkyl derivatives contain a reactive hydrogen which might be a point of attack for biological oxidation. On this assumption, a difference should be expected in the utilization of the nitrogen by fungi. Cultures of *Penicillium expansum* were inoculated into a synthetic medium containing M/50 nitrogen in the form of alkylbarbituric acid. The series included eight mono- and seventeen di-alkylbarbituric acids. A slight growth, far from normal, was obtained on all of the mono-alkyl derivatives, whereas the di-alkyl derivatives gave only germination similar to the controls without nitrogen.

The chemical composition of the body fluids of the sea-lion: R. E. Swain, and N. W. Rakestraw.

The molecular weight and transition point of gelatin: E. T. Oakes, and C. E. Davis.

The non-protein nitrogen of the hen's egg: J. S. Hepburn.

Biochemical studies of insectivorous plants: J. S. Hepburn, E. Q. St. John, and Frank M. Jones.

Studies on the digestibility of proteins in vitro. III. On the chemical nature of the nutritional deficiencies of arachin: D. Breese Jones, and Henry C. Waterman. Estimations of the digestibility *in vitro* of variously treated preparations of arachin (the principal protein of the peanut, *Arachis hypogœa*) by the method of Waterman and Johns indicate: (1) that this protein is incompletely digestible, and that this condition is not altered by boiling with water at ordinary pressure or by cooking under a steam pressure of 15 lbs.; and (2) that the nutritional failure of arachin is due to the retention of a considerable part of one or more of the essential amino acids, the most conspicuous of which is histidine, in the indigestible complex. The total amino acid composition of arachin would almost certainly be quite adequate, if it were available. The experiments indicate that the incomplete digestibility of arachin is not due to changes brought about by the treatment involved in its isolation, but is a native property of the protein. The high nutritional efficiency of peanut meal is therefore to be attributed to the presence in the meal of sources of amino acids which supply essentials contained in an unavailable form in arachin.

A chemical study of the proteins of the adsuki bean, Phaseolus angularis: D. B. Jones, A. J. Finks, and C. E. F. Gersdorff. Two globulins and a small amount of albumin have been isolated from the total proteins of the Japanese adsuki bean, *Phaseolus angularis*. The *a* globulin, obtained in 0.35 per cent. yield, was precipitated from a 5 per cent. sodium chloride extract of the bean meal by making the extract 0.3 saturated with ammonium sulfate, dissolving the resulting precipitate in distilled water and dialyzing the solution in running, chilled water for 9 to 12 days. This globulin coagulated at about 88° C. Elementary analyses of several preparations showed them to

have the following average percentage composition: C 52.75, H 6.97, N 15.64, S 1.21. Analyses by the Van Slyke method gave the following percentages for the diamino acids: Arginine 5.45, histidine 2.25, lysine 8.30; cystine 1.63.

The *b* globulin was precipitated from the saline extract of the meal at 0.65 to complete saturation with ammonium sulfate. This globulin coagulated at about 97° C, which is 10° higher than that of the *a* globulin. It had the following average elementary percentage compositions: C 53.57, N 6.79, N 16.46, S 0.40, and gave by the Van Slyke method: Arginine 7.00 per cent., histidine 2.51 per cent., lysine 8.41 per cent. and cystine 0.86 per cent. The bases were determined also by the absolute method of Kossel and Kutcher with the following results: Arginine 5.08 per cent., histidine 1.75 per cent. and lysine 4.17 per cent. A yield of 2.13 per cent. of tyrosine was also isolated. The most striking difference between the two globulins lies in their sulfur content. Both gave a qualitative test for tryptophane, although faint and slow to develop in the case of the *a* globulin.

The hydrolysis of casein and deaminized casein by enzymes: HOWARD B. LEWIS, and MAX S. DUNN. A study has been made of the digestion *in vitro* of casein and deaminized casein by pepsin, trypsin and erepsin. Both proteins were readily digested by pepsin and trypsin. Erepsin digested casein readily, but attacked deaminized casein only after the preliminary action of pepsin or trypsin. In every case the digestion of deaminized casein proceeded at a slower rate than the digestion of casein.

Synthesis of glycocoll and glutamine in the human body. C. P. SHERWIN.

Revision of Rosanoff's diagram of the aldose sugars: J. J. WILLAMAN and CLARENCE A. MORROW. Rosanoff's diagram showing the structural and genetic relationships among the aldoses is modified and extended. The objects of the revision are: (1) to include all aldoses so far prepared; (2) to rearrange the positions in the diagram so as to obtain geometrical perfection in showing the stereochemical progressions; and (3) to include in the diagram the following facts which were not included in the original: (*a*) the name of the sugar, (*b*) its specific rotation, and (*c*) its occurrence, whether natural or synthetic. Besides these, the facts in the original are also retained: (*d*) the projection formula by means of a symbol, (*e*) the original Fischer designation of family relationship, whether *d* or *l*, and (*f*) an index number, which, referred to a legend, gives the name of the alcohol and the dicarboxyllic acid derivative of the sugar. The revised diagram simplifies the study of stereoisomerism in the sugar group, and argues for the adoption of a rational system of nomenclature in this group.

The constitution of inulin: J. J. WILLAMAN.

Biochemistry of plant diseases. IV. *Effect of the brown rot: Fungus on plums:* J. J. WILLAMAN and F. R. DAVISON. Two varieties of plums resistant to brown rot, and two non-resistant, were picked at three stages of maturity, and subjected to analysis before and after rotting by *Sclerotinia cinerea*. The ash, nitrogen, CaO, ether extract, and crude fiber were consistently higher in the rotted samples, due no doubt to loss of dry matter by respiration. The resistant varieties contained much more crude fiber, but less of the other constituents than the non-resistant. The quality and quantity of the structural elements in the flesh are apparently important factors in resistance properties.

Rennet content of pancreatic extract—method for its isolation: ALBERT A. EPSTEIN. The presence of this enzyme in the pancreas can be readily demonstrated in a number of ways: (1) By heating the secretion or extract of the pancreas (in solution) to temperatures ranging from 50° to 65° C. for a period of 10 to 15 minutes, the most favorable temperature being 60° C. At this temperature and those above it, flocculation occurs and the ferment, which is soluble, remains in the fluid portion. (2) Treatment of the pancreatic ferments by means of colloidal iron and other precipitants such as uranium acetate, alcohol, and sodium sulphate (to saturation). (3) Addition of peptone mixtures such as those of gliadin and Witte's to the pancreatic juice or extract liberates the rennet. (4) Serum of a rabbit immunized by intravenous injections of pancreatic extract when added to the pancreatic extract liberates the rennet. It is concluded from these experiments that rennet is constantly present in the pancreatic secretions and extracts, not as a pro-enzyme but as an active enzyme admixed with substances which are antagonistic to it.

The immunizing substance of the pneumococcus: WILLIAM A. PERLZWEIG. The immunizing substance of the pneumococcus was found to be attached to the protein fraction of the cell. Being resistant to the action of proteolytic enzymes, it can be detached from the proteins by subjecting the bacteria to prolonged tryptic action and further separated by extraction of the digest with an excess of alcohol or acetone. The alcohol soluble

antigen is soluble in water, but it is not extracted from its aqueous solution by lipin solvents. It is heat stable in acid solution. The aqueous solution obtained from the alcoholic extract appears to possess the complete immunizing properties of the original pneumococci when tested prophylactically upon white mice, inducing in the animals an active immunity of a high degree. The antigenic fraction of pneumococci appears to be associated with the vitamine fraction.

Biochemical studies in pellagra: M. X. Sullivan. In the chemical studies of the patients at the Pellagra Hospital, Spartanburg, S. C., no marked evidence of acidosis was noted, though the patients as a whole tended to minimum normal levels. In general the mixture afforded by the results of the biochemical study of patients in the active stage of the disease is that of malnutrition and low protein metabolism with in general a low total nitrogen excretion, a heightened ammonia ratio with low uric and create a low area and a low ratio of urea nitrogen to total nitrogen. The undetermined nitrogen in the active stage of the disease is much higher than normal and contains basic material.

The chemical composition of decayed tomatoes: R. T. Balch and I. K. Phelps. A chemical study of tomatoes decomposed by two molds that cause "soft rots," namely, "*Rhizopus nigricans*" and "*Oidium lactis*" showed a decrease in the sugar content, the acidity, the nitrogen, and to a slight extent the citric acid. There was always a formation of ammonia. These determinations as well as those of the phosphorous in the insoluble solids, the nitrogen in the insoluble solids before and after treatment with 50 per cent. potassium hydroxide, the soluble protein nitrogen and the distribution of the soluble nitrogen would not serve as a means of detecting spoilage in tomato products, excepting in cases where a physical examination would suffice, for the following reasons: (1) The constituents of the tomato are variable. (2) The percentage composition of the tomato is not dependent upon the composition of the tomato alone but varies with the many different processes through which the product goes during its manufacture. (3) The small amount of spoilage that would probably be present would not materially change the composition of the product.

Energy expenditure in sewing: C. F. Langworthy and H. G. Barott. The respiration calorimeter was used to measure the energy expended by a woman hemming by hand on various materials and at different speeds, and doing similar sewing on a machine driven by foot power and by electricity. Little variation was found in the energy required for hand hemming on fine handkerchiefs, cotton sheets, 8-ounce cotton duck, and army blankets, the energy required for the actual sewing ranging from 4.3 calories per hour in the case of army blankets to 5.8 calories in the case of handkerchiefs. When the speed of sewing was increased, the energy output increased proportionately. Hemming sheets on a foot-driven machine required about six times as much energy per hour as doing the same work by hand, but the energy used per meter of sewing was hardly one half as great. When an electrically driven machine was used the energy required per hour was not quite twice that used for hand sewing and about one fourth that for the foot-driven machine; the energy per meter of sewing was about one fifth of that measured on the foot-driven machine and less than one tenth that of hand sewing. A three weeks' attack of influenza during the progress of the experiments made it possible to compare the energy output of the subject before and after the infection. For five weeks after apparently complete recovery her energy expenditure per kilogram of body weight averaged nearly 4 per cent. lower than before her illness.

Loss of carbon dioxid from dough as an index of flour strength: C. H. Bailey and Mildred Weigley. Two groups of factors appear involved in determining baking strength of flour: (*a*) the rate of gas production and (*b*) gas retention in the dough. The former can be varied in the desired direction, while the latter is apparently related to the percentage and physical properties of the gluten proteins and is more difficult to control. A study of the rate of expansion, and the loss of carbon dioxid from doughs made with strong and weak flours indicates that weak flour doughs lose more carbon dioxid per unit increase in volume than do strong flours. The loss of carbon dioxid per unit volume increase is suggested as a useful criterion of comparative strength of flours.

Studies of wheat flour grades. III. *Effect of chlorine bleaching upon the electrolytic resistance and hydrogen-ion concentration of water extracts:* C. H. Bailey and Arnold Johnson. Bleaching of flour with chlorine effects an appreciable increase in the conductivity and hydrogen-ion concentration of its water extract. The modification of these properties is in direct ratio to the quantity of chlorine employed in treating the flour.

Charles L. Parsons,
Secretary

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THE MESSAGE OF SCIENCE.[1]

It is just forty years ago, at the York Meeting in 1881, that a committee was appointed "to arrange for a conference of delegates from scientific societies to be held at the annual meetings of the British Association, with a view to promote the interests of the societies represented by inducing them to undertake definite systematic work on a uniform plan." The association had been in existence for fifty years before it thus became a bond of union between local scientific societies in order to secure united action with regard to common interests. Throughout the whole period of ninety years it has been concerned with the advancement and diffusion of natural knowledge and its applications. The addresses and papers read before the various sections have dealt with new observations and developments of scientific interest or practical value; and, as in scientific and technical societies generally, questions of professional status and emolument have rarely been discussed. The port of science—whether pure or applied—is free, and a modest yawl can find a berth in it as readily as a splendid merchantman, provided that it has a cargo to discharge. Neither the turmoil of war nor the welter of social unrest has prevented explorers of uncharted seas from crossing the bar and bringing their argosies to the quayside, where fruits and seeds, rich ores and precious stones have been piled in profusion for the creation of wealth, the comforts of life, or the purpose of death, according as they are selected and used.

All that these pioneers of science have asked for is for vessels to be chartered to enable them to make voyages of discovery to

[1] Address by Sir Richard Gregory, president of the Conference of Delegates of Corresponding Societies, given at the Edinburgh meeting of the British Association for the Advancement of Science.

unknown lands. Many have been private adventurers, and few have shared in the riches they have brought into port. Corporations and governments are now eager to provide ships which will bring them profitable freights, and to pay bounties to the crews, but this service is dominated by the commercial spirit which expects immediate returns for investments, and mariners who enter it are no longer free to sail in any direction they please or to enter whatever creek attracts them. The purpose is to secure something of direct profit or use, and not that of discovery alone, by which the greatest advances of science have hitherto been achieved.

When science permits itself to be controlled by the spirit of profitable application it becomes merely the galley-slave of short-sighted commerce. Almost all the investigations upon which modern industry has been built would have been put aside at the outset if the standard of immediate practical value had been applied to them. To the man of science discoveries signify extensions of the field of work, and he usually leaves their exploitation to prospectors who follow him. His motives are intellectual advancement, and not the production of something from which financial gain may be secured. For generations he has worked in faith purely for the love of knowledge, and has enriched mankind with the fruits of his labors; but this altruistic attribute is undergoing a change. Scientific workers are beginning to ask what the community owes to them, and what use has been made of the talents entrusted to it. They have created stores of wealth beyond the dreams of avarice, and of power unlimited, and these resources have been used to convert beautiful countrysides into grimy centers of industrialism, and to construct weapons of death of such diabolical character that civilized man ought to hang his head in shame at their use.

Mankind has, indeed, proved itself unworthy of the gifts which science has placed at its disposal, with the result that squalid surroundings and squandered life are the characteristics of modern Western civilization, instead of social conditions and ethical ideals superior to those of any other epoch. Responsibility for this does not lie with scientific discoverers, but with statesmen and democracy. Like the gifts of God, those of science can be made either a blessing or a curse, to glorify the human race or to destroy it; and upon civilized man himself rests the decision as to the course to follow. With science as an ally, and the citadels of ignorance and self as the objective, he can transform the world, but if he neglects the guidance which knowledge can give, and prefers to be led by the phrases of rhetoricians, this planet will become a place of dust and ashes.

Unsatisfactory social conditions are not a necessary consequence of the advance of science, but of incapacity to use it rightly. Whatever may be said of captains of industry or princes of commerce, scientific men themselves can not be accused of amassing riches at the expense of labor, or of having neglected to put into force the laws of healthy social life. Power—financial and political—has been in the hands of people who know nothing of science, not even that of man himself, and it is they who should be arraigned at the bar of public justice for their failure to use for the welfare of all the scientific knowledge offered to all. Science should dissociate itself entirely from those who have thus abused its favors, and not permit the public to believe it is the emblem of all that is gross and material and destructive in modern civilization. There was a time when intelligent working men idealized science; now they mostly regard it with distrust or are unmoved by its aims, believing it to be part of a soul-destroying economic system. The obligation is upon men of science to restore the former feeling by removing their academic robes and entering into social movements as citizens whose motives are above suspicion and whose knowledge is at the service of the community for the promotion of the greatest good. The public mind has yet to understand that science is the pituitary body of the social organism, and without

it there can be no healthy growth in modern life, mentally or physically.

This Conference of Delegates provides the most appropriate platform of all those offered by the British Association from which a message of exhortation may be given. There are now 130 Corresponding Societies of the Association, with a total membership of about 52,000, and their representatives should every year go back not only strong with zeal for new knowledge, but also as ministers filled with the sense of duty to inspire others to trust in it. In mechanics work is not considered to be done until the point of application of the force is moved; and knowledge, like energy, is of no practical value unless it is dynamic. The scientific society which shuts itself up in a house where a favored few can contemplate its intellectual riches is no better than a group of misers in its relations to the community around it. The time has come for a crusade which will plant the flag of scientific truth in a bold position in every province of the modern world. If you believe in the cause of disciplined reason you will respond to the call and help to lift civilized man out of the morass in which he is now struggling, and set him on sound ground with his face toward the light.

It is not by discoveries alone, and the records of them in volumes rarely consulted, that science is advanced, but by the diffusion of knowledge and the direction of men's minds and actions through it. In these democratic days no one accepts as a working social ideal Aristotle's view of a small and highly cultivated aristocracy pursuing the arts and sciences in secluded groves and maintained by manual workers excluded from citizenship. Artisans to-day have quite as much leisure as members of professional classes, and science can assist in encouraging the worthy employment of it. This end can be attained by cooperative action between local scientific societies and representative organizations of labor. There should be close association and a common fellowship, and no suggestion of superior philosophers descending from the clouds to dispense gifts to plebeian assemblies. Above all, it should be remembered that a cause must have a soul as well as a body. The function of a mission-hall is different from that of a cinema-house or other place of entertainment, and manifestations of the spirit of science are more uplifting than the most instructive descriptive lectures.

Science needs champions and advocates, in addition to actual makers of new knowledge and exponents of it. There are now more workers in scientific fields than at any other time, yet relatively less is done to create enthusiasm for their labor and regard for its results than was accomplished fifty years ago. Every social or religious movement passes through like stages, from that of fervent belief to formal ritual. In science specialization is essential for progress, but the price which has to be paid for it is loss of contact with the general body of knowledge. Concentration upon any particular subject tends to make people indifferent to the aims and work of others; for, while high magnifying powers enable minute details to be discerned, the field of vision is correspondingly narrowed, and the relation of the structure as a whole to pulsating life around it is unperceived.

As successful research is now necessarily limited for the most part to complex ideas and intricate details requiring special knowledge to comprehend them, very special aptitude is required to present it in such a way as will awaken the interest of people familiar only with the vocabulary of everyday life. In the scientific world the way to distinction is discovery, and not exposition, and rarely are the two faculties combined. Most investigators are so closely absorbed in their researches that they are indifferent as to whether people in general know anything of the results or not. In the strict sense of the word, science can never be popular, and its pure pursuit can never pay, but where one person will exercise his intelligence to understand the description of a new natural fact or principle a thousand are ready to admire the high purpose of a scientific quest and reverence the

disinterested service rendered by it to humanity. The record of discovery or description of progress is, therefore, only one function of a local scientific society; beyond this is the duty of using the light of science to reveal the dangers of ignorance in high as well as in low places. Though in most societies there is only a small nucleus of working members, the others are capable of being interested in results achieved, and a few may be so stimulated by them as to become just and worthy knights of science, ready to remove any dragons which stand in the way of human progress, and continually upholding the virtues of their mistress.

Every local scientific society should be a training ground for these Sir Galahads, and an outpost of the empire of knowledge. The community should look to it for protection from dangers within and without the settlement, and for assistance in pressing further forward into the surrounding woods of obscurity. At present it is unusual for this civic responsibility to be accepted by a scientific society, with the result that local movements are undertaken without the guidance necessary to make them successful. A local scientific society should be the natural body for the civic authority to consult before any action is taken in which scientific knowledge will be of service. It should be to the city or county in which it is situated what the Royal Society is to the State, and not a thing apart from public life and affairs. As an example of what a local society may usefully do, the action taken by the Manchester Field Naturalists' and Archæologists' Society several years ago may be mentioned. The Society appointed a Committee for the purpose of promoting the planting of trees and shrubs in Manchester and its immediate suburbs. The idea commended itself to the Corporation, and the Committee obtained advice as to the best trees for open spaces in the district, shrubs for tubs and boxes, and tree culture in towns generally. This is the kind of guidance which a scientific society should be particularly competent to give, and which the community has a right to expect from it. Many similar questions continually arise in which ascertained knowledge can be used for the promotion of healthy individual and social life, and if scientific societies are indifferent to them they neglect their best opportunities of playing a strong part in the scheme of human progress.

When wisdom is justified of her children, and local scientific societies are no longer esoteric circles, but effective groups of enlightened citizens of all classes, they will provide the touchstone by which fact is distinguished from assertion and promise from performance. As the sun draws into our system all substantial bodies which come within its sphere of influence, while the pressure of sunlight drives away the fine dust which would tend to obscure one body from another, so a local scientific society possesses the power of attracting within itself all people of weight in the region around it and of dispersing the mist and fog which commonly prevail in the social atmosphere. Thus may the forces of modern civilization, moral and material, be brought together, and an allied plan of campaign instituted against the armies of ignorance and sloth. The service is that of truth, the discipline that of scientific investigation, and the unifying aim human well-being. Kingsley long ago expressed the democratic basis upon which this fellowship is founded. "If," he said, "you want a ground of brotherhood with men, not merely in these islands, but in America, on the Continent—in a word, all over the world—such as rank, wealth, fashion, or other artificial arrangements of the world can not give and can not take away; if you want to feel yourself as good as any man in theory, because you are as good as any man in practice, except those who are better than you in the same line, which is open to any and every man, if you wish to have the inspiring and ennobling feeling of being a brother in a great freemasonry which owns no difference of rank, of creed, or of nationality—the only freemasonry, the only International League which is likely to make mankind (as we all hope they will be some day) one—then be-

come men of science. Join the freemasonry in which Hugh Miller, the poor Cromarty stonemason, in which Michael Faraday, the poor bookbinder's boy, became the companions and friends of the noblest and most learned on earth, looked up to by them not as equals merely, but as teachers and guides, because philosophers and discoverers."

When Kingsley delivered this message artisans were crowding in thousands to lectures in Manchester and other populous places by leaders in the scientific world of that time. Labor then welcomed science as its ally in the struggle for civil rights and spiritual liberty. That battle has been fought and won, and subjects in bitter dispute fifty years ago now repose in the limbo of forgotten things. There is no longer a conflict between religion and science, and labor can assert its claims in the market-place or council house without fear of repression. Science is likewise free to pursue its own researches and apply its own principles and methods within the realm of observable phenomena, and it does not desire to usurp the functions of faith in sacred dogmas to be perpetually retained and infallibly declared. The Royal Society of London was founded for the extension of *natural* knowledge in contra-distinction to the *supernatural*, and it is content to leave priests and philosophers to describe the world beyond the domain of observation and experiment. When, however, phenomena belonging to the natural world are made subjects of supernatural revelation or uncritical inquiry, science has the right to present an attitude of suspicion towards them. Its only interest in mysteries is to discover the natural meaning of them. It does not need messages from the spirit world to acquire a few elementary facts relating to the stellar universe, and it must ask for resistless evidence before observations contrary to all natural law are accepted as scientific truth. If there are circumstances in which matter may be divested of the property of mass, fairies may be photographed, lucky charms may determine physical events, magnetic people disturb compass needles, and so on, by all means let them be investigated, but the burden of proof is upon those who believe in them and every witness will be challenged at the bar of scientific opinion.

We do not want to go back to the days when absolute credulity was inculcated as a virtue and doubt punished as a crime. It is easy to find in works of uncritical observers of mediæval times most circumstantial accounts of all kinds of astonishing manifestations, but we are not compelled to accept the records as scientifically accurate and to provide natural explanations of them. We need not doubt the sincerity of the observer even when we decline to accept his testimony as scientific truth. The maxim that "Seeing is believing" may be sound enough doctrine for the majority of people, but it is insufficient as a principle of scientific inquiry. For thousands of years it led men to believe that the earth was the center of the universe, with the sun and other celestial bodies circling round it, and controlling the destiny of man, yet what seemed obvious was shown by Copernicus to be untrue. This was the beginning of the liberation of human life and intellect from the maze of puerile description and philosophic conception. Careful observation and crucial experiment later took the place of personal assertion and showed that events in Nature are determined by permanent law and are not subject to haphazard changes by supernatural agencies. When this position was gained by science, belief in astrology, necromancy, and sorcery of every kind began to decline, and men learned that they were masters of their own destinies. The late War is responsible for a recrudescence of these mediæval superstitions, but if natural science is true to the principles by which it has advanced it will continue to bring to bear upon them the piercing light by which civilized man was freed from their baleful consequences.

There is abundant need for the use of the intellectual enlightenment which science can supply to counteract the ever-present tendency of humanity to revert to primitive ideas. Fifty years of compulsory education are but

a moment in the history of man's development, and their influence is as nothing in comparison with instincts derived from our early ancestors and traditions of more recent times grafted upon them. So little is known of science that to most people old women's tales or the single testimony of a casual onlooker are as credible as the statements and conclusions of the most careful observers. Where exact knowledge exists, however, to place opinion by the side of fact is to blow a bubble into a flame. Within its own domain science is concerned not with belief—except as a subject of inquiry—but with evidence. It claims the right to test all things in order to be able to hold fast to that which is good. It declines to accept popular beliefs as to thunderbolts; living frogs and toads embedded in blocks of coal or other hard rock without an opening, though the rock was formed millions of years ago and all fossils found in it are crushed as flat as paper; the inheritance of microbic diseases; the production of rain by explosions when the air is far removed from its saturation point; the influence of the moon on the weather or of underground water upon a twig held by a dowser, and dozens of like fallacies, solely because when weighed in the balance they have been found wanting in scientific truth. Its only interest in mysteries is that of inquiring into them and finding a natural reason for them. Mystery is thus not destroyed by knowledge but removed to a higher plane.

Never let it be acknowledged that science destroys imagination, for the reverse is the truth. "The Gods are dead," said W. E. Henley.

> The world, a world of prose,
> Full-crammed with facts, in science swathed and sheeted,
> Nods in a stertorous after-dinner doze!
> Plangent and sad, in every wind that blows
> Who will may hear the sorry words repeated:—
> "The Gods are dead."

It is true that the old idols of wood and stone are gone, but far nobler conceptions conceptions have taken their place. The universe no longer consists of a few thousand lamps lit nightly by angel torches, but of millions of suns moving in the infinite azure, into which the mind of man is continually penetrating further. Astronomy shows that realms of celestial light exist where darkness was supposed to prevail, while scientific imagination enables obscure stars to be found which can never be brought within the sense of human vision, the invisible lattice work of crystals to be discerned, and the movements of constituent particles of atoms to be determined as accurately as those of planets around the sun. The greatest advances of science are made by the disciplined use of imagination; but in this field the picture conceived is always presented to Nature for approval or rejection, and her decision upon it is final. In contemporary art, literature, and drama imagination may be dead, but not in science, which can provide hundreds of arresting ideas awaiting beautiful expression by pen and pencil. It has been said that the purpose of poetry is not truth, but pleasure; yet, even if this definition be accepted, we submit that insight into the mysteries of Nature should exalt, rather than repress, the poetic spirit, and be used to enrich verse, as it was by some of the world's greatest poets—Lucretius, Dante, Milton, Goethe, Tennyson, and Browning. With one or two brilliant exceptions, popular writers of the present day are completely oblivious to the knowledge gained by scientific study, and unmoved by the message which science is alone able to give. Unbounded riches have been placed before them, yet they continue to rake the muck-heap of animal passions for themes of composition. Not by their works shall we become "children of light," but by the indomitable spirit of man ever straining upwards to reach the stars.

Where there is ignorance of natural laws all physical phenomena are referred to supernatural causes. Disease is accepted as Divine punishment to be met by prayer and fasting, or the act of a secret enemy in communion with evil spirits. Because of these beliefs thousands of innocent people were formerly burnt and tortured as witches and

sorcerers, while many thousands more paid in devastating pestilences the penalty which Nature inevitably exacts for crimes against her. In one sense it may be said that the human race gets the diseases it deserves; but the sins are those of ignorance and neglect of physical laws rather than against spiritual ordinances. Plague is not now explained by supposed iniquities of the Jews or conjunctions of particular planets, but by the presence of an organism conveyed by fleas from rats; malaria and yellow fever are conquered by destroying the breeding places of mosquitoes; typhus fever by getting rid of lice; typhoid by cleanliness; tuberculosis by improved housing; and most like diseases by following the teachings of science concerning them. Though the mind does undoubtedly influence the resistance of the body to invasion by microbes, it can not create the specific organism of any disease, and the responsibility of showing how to keep such germs under control, and prevent, therefore, the poverty and distress due to them, is a scientific rather than a spiritual duty.

The methods of science are pursued whenever observations are made critically, recorded faithfully, and tested rigidly, with the object of using conclusions based upon them as stepping-stones to further progress. They demand an impartial attitude towards evidence and fearless judgment upon it. These are the principles by which the foundations of science have been laid, and a noble structure of natural knowledge erected upon them. A scientific inquiry is understood to be one undertaken solely with the view of arriving at the truth, and this disinterested motive will always command public confidence. It is poles apart from the spirit in which social and political subjects are discussed: it is the rock against which waves of emotion and storms of rhetoric lash themselves in vain. If political science were guided by the same methods it would present an open mind to all sides of a question, weighing objections to proposals as justly as reasons in support of them, whereas usually it sees only the views of a particular class or party, and can not be trusted, therefore, to strike a judicial balance. The methods of science should be the methods applied to social problems if sound principles of progress are to be determined. When they are so used a statesman will be judged, as a scientific man is judged, by correct observation, just inference, and verified prediction; in their absence politics will remain stranded on the shifting sands of barter, concession, and expediency.

Democracy may be politically an irrational force, but that is all the more reason why those who direct it should have full knowledge of the possibilities offered by science for construction as well as for destruction. In a chemical research an experiment is not the haphazard mixture of substances made in the hope that something good will come from it, but the deliberate test of consequences which ought to follow if certain ideas are true. So with all scientific experiment: reason is the source of action, and principles are tested by results. Social problems are perhaps more complicated than those of the laboratory, yet the only way to discover solutions of them is to apply scientific standards to the methods used and results obtained. Laws of Nature are merely expressions of our knowledge at a particular epoch, and they are more precise than those of political economy because they are investigated purely from the point of view of progress. If the general laws which constitute the science of sociology are to be discovered and accepted, their study must be as impartial as that of any other science. "The discovery of exact laws," said W. K. Clifford, "has only one purpose—the guidance of conduct by means of them. The laws of political economy are as rigid as those of gravitation; wealth distributes itself as surely as water finds its level. But the use we have to make of the laws of gravitation is not to sit down and cry 'Kismet' to the flowing stream, but to construct irrigation works."

Organized Labor has on more than one occasion pronounced a benison upon scientific research, and urged that full facilities should be afforded to those who undertake it.

Not long ago the American Federation of Labor in convention assembled resolved 'that a broad programme of scientific and technical research is of major importance to the national welfare,' and in a noteworthy document insisted upon its essential value in the development of industries, increased production, and the general welfare of the workers. The British Labor Party has also stated that it places the 'advancement of science in the forefront of its political programme,' but its manifesto refers particularly to the 'undeveloped science of society' rather than to the science of material things; and whatever labor may declare officially, it is scarcely too much to say that artisans in general show less active interest in scientific knowledge now than they did fifty years ago. Not by the study of science does a manual worker become a leader among his fellows but by the discovery of wrongs to be remedied or rights to be established, and by fertility of resource in disputations concerning them. This is natural enough, yet when we remember that many of the greatest pioneers in the fields of pure and applied science were of humble origin it is surprising that labor makes no effort to keep men of this type within its lodges.

If trades unions were true to their title, and not merely wage unions, their members would give as much attention to papers on scientific principles of their industry, craftsmanship, and possible new developments as they do to the consideration of the uttermost they can claim and secure for their members. Not a single labor organization concerns itself with actual means of industrial progress, but only with the sharing of the profits from processes or machinery devised by others. Labor may express approval of scientific and technical research, but if it wishes to be a creative force it should take part in this work instead of limiting itself to getting the greatest possible advantage from the results. Under present conditions an artisan with original ideas or inventive genius has to go outside the circle of his union to describe his work, and he thus becomes separated from his fellows through no fault of his own. His contributions are judged by a scientific or technical society purely on their merit and without any consideration as to his social position. Labor can never be great until it affords like opportunities to its own original men by accepting and issuing papers upon discoveries of value to science and industry. When it does this, and its publications occupy an honored place among those of scientific and technical societies, it will be able to command a position in national polity which can never be justly conceded to any organization concerned solely with the rights and privileges of a single class in the community.

We know, of course, that few workmen can be expected to possess sufficient knowledge and originality to make developments important enough to be recorded in papers for the benefit of science or industry generally, but every such contribution published by a trade union or other labor organization, federated or otherwise, would do far more to command respect than sheaves of pamphlets upon economic aspects of industry from the point of view of workpeople. If no fundamental or suggestive papers of this kind are forthcoming, or if organized labor persists in its policy of letting its men of practical genius find elsewhere the people who know how to appreciate them, it is tacitly acknowledged that others are expected to provide the seeds of industrial developments while labor concerns itself solely with the distribution of the fruits derived from them.

It is true that some of the leaders of the labor movement realize that close association with progressive science is essential to the expansion of industry and the consequent provision of wages in the future. What is here urged is that labor should itself take part in the scientific and industrial research which it acknowledges is necessary for existence, and should show by its own contributions that it possesses the power to produce useful knowledge as well as the dexterity to apply it. The machinery of trade unionism is capable of much more extensive use than

that to which it has hitherto been put, and when it is concerned not only with securing "for the producers by hand or by brain the full fruits of their industry," but also with the creation of new plantations by its own efforts, no one will be able to doubt its fitness to exercise a controlling influence upon modern industry.

The Workers' Educational Association has proved that very many artisans are ready to take advantage of opportunities of becoming familiar with the noblest works of literature, science, and art, with the single motive of enriching their outlook upon life. Many more attend classes in economics, and nearly all are in favor of extended facilities for further education, though there is a difference of intention between the Marxian element in labor and the more impartial supporters of the W. E. A. or of the Co-operative Education Union. "There is practically no limit," says Mr. G. D. H. Cole in "An Introduction to Trade Unionism," "to what could be done if there only existed among the national and local leaders of Labor a clear idea of the part which education must play if the working-class is ever to achieve emancipation from the wage system." To education should be added original research if labor is to signify something more than a class of hewers of wood and drawers of water. The Guild movement represents a step in this direction, but if it signifies merely a return to the mediæval system it can scarcely be so important a factor of general development as its advocates imagine, and it may mean the institution of caste in labor. Such a system no doubt leads to perfection of craftsmanship, and it is to be welcomed as an antidote to the deadening influence of specialized industry; but a caste nation at last becomes stationary, for in each caste a habit of action and a type of mind are established which can only be changed with difficulty. What is wanted to make the race strong is cross-fertilization, and not inbreeding.

Local scientific societies should provide a common forum where workers with hand or brain can meet to consider new ideas and discuss judicially the significance of scientific discovery or applied device in relation to human progress. At present such societies are mostly out of touch with these practical aspects of knowledge, and are more interested in prehistoric pottery than in the living world around them. Most of those connected with the British Association are concerned with natural history, but all scientific societies in a district should form a federation to proclaim the message of knowledge from the house-tops. Men are ready to listen to the gospel of science and to believe in its power and its guidance, but its disciples disregard the appeal and are content to let others minister to the throbbing human heart. Civilization awaits the lead which science can give in the name of wisdom and truth and unprejudiced inquiry into all things visible and invisible, but the missionary spirit which would make men eager to declare this noble message to the world has yet to be created.

This is as true of the British Association itself as it is of local scientific societies. It seems to be forgotten that one of the functions of the Association is to inspire belief and confidence in science as the chief formative factor of modern life, and not only to display discoveries or enable specialists to discuss technical advances in segregated sections. Though members of the Association may be able to live on scientific bread alone, most of the community in any place of meeting need something more spiritual to awaken in them the admiration and belief which beget confidence and hope. They ask for a trumpet-call which will unite the forces of natural and social science, and are unmoved by the parade of trophies of scientific conquests displayed to them. It was the primary purpose of Canon W. V. Harcourt, the chief founder of this Association, and General Secretary from 1831 to 1837, to sound this note for "the stimulation of interest in science at the various places of meeting, and through it the provision of funds for carrying on research," and not for "the discussion of scientific subjects in the sections." In the course of time these sectional discussions have taken

a prominent place in the Association's programme, and rightly so, for they have promoted the advancement of science in many directions; but, while we recognize their value to scientific workers, we plead for something more for the great mass of people outside the section-rooms, for a statement of ideals and of service, of the strength of knowledge and of responsibility for its use. These are the subjects which will quicken the pulse of the community and convert those who hate and fear science and associate it solely with debasing aspects of modern civilization into fervent disciples of a new social faith upon which a lever made in the workshops of natural knowledge may be placed to move the world.

Richard Gregory

A NOTABLE MATHEMATICAL GIFT

As trustee of the Edward C. Hegeler Trust fund Mrs. Mary Hegeler Carus, of La Salle, Illinois, recently promised to make the Mathematical Association of America a yearly contribution of twelve hundred dollars for five years to be used for the publication of mathematical monographs under the auspices of this association. As is well known the publication of scientific literature has been much hampered in recent years by the greatly increased cost of publication. Hence this gift is especially timely and noteworthy.

The letter confirming this gift was addressed to Professor Slaught, of the University of Chicago, and includes the following significant statement:

> If at the end of five years this project shall have proved successful it is my intention to then give to the Association a permanent endowment fund, and I will so direct my legal representatives, which will yield at least twelve hundred dollars annually.

As the great success of the project seems practically assured in view of the wide and deep interest already manifested therein on the part of leading mathematicians the Mathematical Association of America seems to have good reasons for expecting a substantial permanent endowment to aid it in the futherance of its great cause of improving collegiate mathematics.

There are now three national mathematical organizations in America. The oldest of these is the American Mathematical Society, which was organized in 1888 as the New York Mathematical Society, but was reorganized about six years later under its present name. This Society devotes most of its energies to mathematical research, and, to further this cause, Professor L. L. Conant, who died in 1916, bequeathed to it ten thousand dollars, subject to Mrs. Conant's life interest, the income of which is to be offered once in five years as a prize for original work in pure mathematics.

The Mathematical Association of America was organized in 1915 with a view towards supplementing the work of the American Mathematical Society along the line of collegiate teaching. It has always collaborated with the Society holding joint meetings with it and having a large common membership. The gift announced above will make it possible to collaborate still more effectively in promoting the interests of advanced mathematics in this country. The National Council of Teachers of Mathematics, organized in 1920, is mainly devoted to the interests of the teaching of secondary mathematics and hence represents more distinctly a separate field, but it too has already begun to cooperate with the Mathematical Association of America.

The latter organization took steps several years ago towards the publication of a modern mathematical dictionary and has a standing committee on this subject. It has, however, not yet been able to push this laudable enterprise on account of lack of funds. The difficulty of such a work is increased by the fact that at present there exists no good mathematical dictionary in any language, and hence most of the material for such a work has to be collected from original sources.

G. A. Miller

University of Illinois

A NEW ALASKA BASE MAP

The U. S. Coast and Geodetic Survey of the Department of Commerce reports the completion of a new outline map of Alaska on the Lambert conformal conic projection,

scale 1/5,000,000; dimensions $17 \times 26\frac{1}{2}$ in., price 25 cents.

The map extends from the Arctic Ocean in the north to the State of Washington in the south, and includes all of the Aleutian Islands and a part of Eastern Siberia. It is intended merely as a base map to which may be added any kind of special information that may be desired. For this reason only national boundaries, the adjacent Canadian provinces, and the names of a few of the important towns are given. The shoreline is compiled from the most recent Coast and Geodetic Survey charts and in respect to southeast Alaska and westward to Kodiak Island, the coast-line is better represented than heretofore. The accumulation of the yearly surveys in the extensive and largely unsurveyed waters of Alaska as here embodied, presents a delineation of the coastline in a more really true shape than heretofore and in this respect the map is more reliable than other existing maps of similar scale.

In addition to this feature, the employment of a more suitable system of map projection adds to the general accuracy. On account of the predominating east and west extent of Alaska, the Lambert conformal conic projection with two standard parallels offers advantages over other projections formerly used in mapping this region. This is the system which came to prominent notice during the World War and was employed by the allied forces in their military operations in France.

The parallels employed as standards are the latitudes 55° and 65°, and along these parallels the scale is true. Between these parallels the scale becomes too small by less than four-tenths of one per cent., which amount is insignificant. At Dixon entrance in southeast Alaska, the former general chart of Alaska on a polyconic projection was in error by as much as ten per cent. due to a system of projection which was unsuited to the shape of the area involved. In the new base map, the projection error in this locality is entirely eliminated. The maximum error of scale of the Lambert projection is only 1 3/4 per cent. This is in the latitude of Pt. Barrow in the north where the scale is too large by this amount. The same amount of error appears in latitude 48° but this is considerably south of Alaska, which is the subject of the map. The polyconic projection had the effect of exaggerating areas in the most important part of Alaska whereas in the Lambert projection the maximum scale error is placed in the least important part of Alaska, and in amount is only one sixth as large as in the polyconic projection.

For the measurement of distances and areas within the extent of the map, an accuracy is thus obtained that is well within the limits of draftsmanship, paper distortion, and our knowledge of this region as a whole.

The selection of a suitable projection with a conformal grid system of one degree units, makes the new outline map a convenient base for the addition of special and useful information. The inclusion of the northwest part of the state of Washington serves as a connecting link with a similar Lambert conformal base map of the United States which has already been published on the same scale.

SCIENTIFIC EVENTS

INVESTIGATIONS OF THE U. S. BUREAU OF MINES ON OZONE AND VENTILATION

The Pittsburgh Experiment Station of the United States Bureau of Mines, according to a bulletin of the bureau, is working in cooperation with the Research Bureau of the American Society of Heating and Ventilating Engineers on a number of problems which affect each individual in his home life, in his place of business, and especially in those places where many people congregate, as in churches, school-rooms and theaters. It is important to ventilate such places with sufficient fresh air to make every one comfortable enough to be able to work at high efficiency. The circulation of excessive quantities of fresh air imposes a considerable cost on the heating system, therefore an efficiently designed heating and ventilating system introduces the least amount of cooled air con-

sistent with proper conditions for health. In this connection the use of ozone has frequently been proposed and actually tried in a number of places. The ozone is supposed to deodorize and purify the air by the oxidation of organic matter and possibly by killing bacteria.

It is, however, a question as to whether ozone can be introduced in quantities large enough to kill bacteria without producing very serious irritation of the throat and lung tissues. It is also a question as to whether harmful oxides of nitrogen are not produced simultaneously with ozone. Definite information is needed on this subject. The first step in obtaining such information is to work out methods for accurately determining the percentage of ozone and oxides of nitrogen produced for different types of ozone machines and to develop suitable methods for determining the very small quantities of ozone and oxides of nitrogen that may be present in air treated with such machines. Analytical work of the highest precision is required. The gas laboratory of the Bureau of Mines Pittsburgh Experiment Station is now engaged on this problem, working in cooperation with the Research Bureau of the American Society of Heating and Ventilating Engineers which is housed in the same building.

After the chemists have worked out the methods of detecting and analysing these small quantities of ozone and oxides of nitrogen, the next problem will be undertaken in a like cooperation of the two agencies just named working with the United States Public Health Service. Surgeons from this service are detailed to the Bureau of Mines for working on health and sanitation problems. The work is being carried on under the joint general direction of A. C. Fieldner, supervising chemist and superintendent of the Pittsburgh Station of the Bureau of Mines, and Dr. R. R. Sayers, chief surgeon of the Bureau of Mines, by G. W. Jones, assistant gas chemist, W. P. Yant, assistant analytical chemist, and O. W. Armspach, engineer of the American Society of Heating and Ventilating Engineers.

THE PUEBLO BONITO EXPEDITION OF THE NATIONAL GEOGRAPHIC SOCIETY

Neil M. Judd, curator of American archeology in the U. S. National Museum, has returned to Washington from New Mexico where he has been engaged, during the past five months, as director of the National Geographic Society's Pueblo Bonito Expedition. This first summer's explorations in Pueblo Bonito—one of the largest and best preserved prehistoric ruins in the United States—is reported to have been entirely successful and to have prepared the way for more intensive research next season. Over forty dwellings and five large ceremonial rooms were excavated; a considerable collection of artifacts and much valuable data were recovered.

As a unique feature of the National Geographic Society's newest expedition it is proposed to hold an annual symposium at Pueblo Bonito—a conference to which will be invited leaders in various branches of science. The first of these meetings, held late in August, was attended by several archeologists and agriculturists; geologists, botanists and soil experts will be invited to the next conference. Through the willing cooperation of these specialists, each expert in his own branch of science, it is hoped to gain a deeper understanding of the conditions under which the ancient inhabitants of Pueblo Bonito carried on their numerous activities; *i.e.*, the geophysical conditions which obtained in their day, the source and extent of their water supply, their methods of agriculture, the character and variety of their foodstuffs, as well as an index as to their cultural attainments, through careful examination of the archeological data recovered. This is the first instance, it is believed, in which American men of widely differing fields of science have joined in solution of a common problem.

THE STEELE CHEMICAL LABORATORY OF DARTMOUTH COLLEGE

At the dedication of the Steele Chemical Laboratory, according to the account in the Boston *Transcript*, the assembly included Governor Albert A. Brown of New Hampshire, former Governor Pingree of Vermont, Dean

Henry P. Talbot of the Massachusetts Institute of Technology, Dr. William H. Nichols of New York City, members of the board of trustees of Dartmouth College, and a number of prominent chemists of New England. Addresses were made by Dr. Nichols, who spoke of the late Sanford H. Steele, a former associate in the General Chemical Company, and an alumnus of Dartmouth, whose bequest of $250,000 made the new building possible, and by Dean Talbot, who reviewed the outstanding achievements of the last fifty years in the study of chemistry.

The Steele chemistry building, which has just been completed at a cost of half a million dollars, embodies the best features of over a score of laboratories inspected by the architects and members of the Dartmouth chemistry department. Much of the apparatus of its equipment has been specially constructed according to designs of Dartmouth chemists.

Nine laboratory rooms are contained in the building, varying from the large laboratory for beginners which will accommodate 144 men working at one time to the laboratory for advanced organic chemistry which will accommodate about fifteen men. Laboratories for qualitative analysis, quantitative analysis, physiological chemistry, physical chemistry, organic chemistry and advanced courses in each of these studies are included. The new building also contains offices and laboratory suites for instructors and professors as well as a large library, lecture room, and conductivity rooms. Specially designed and constructed systems for ventilation, and distribution of gas, electricity, compressed air and distilled water have been installed. The building is Georgian in type, to harmonize with other Dartmouth buildings. It was designed by Larson & Wells of Hanover, and erected by the Cummings Construction of Ware, Mass.

Members of the Ouroborus Club, a society of chemists, holding its fall meeting at Hanover, were guests at the dedication exercises and included Professors Talbot, Norris, Moore, Williams, Smith and Lewis of the Massachusetts Institute of Technology; Kohler and Lamb, of Harvard; Jennings and Zinn, of Worcester; Hopkins, Doughty and Scatchard, of Amherst; Chamberlain and Morse of Massachusetts Agricultural College; Mears of Williams; Johnson of Yale; Hoover of Wesleyan; and Bartlett, Bolser and Richardson of Dartmouth.

LECTURES ON PUBLIC HYGIENE AT THE UNIVERSITY OF PENNSYLVANIA

A second series of ten lectures on "Public Hygiene" to be given under the auspices of the school of Hygiene and Public Health at the University of Pennsylvania is announced as follows: October 15. "The factors that determine disease and death." Professor D. H. Bergey, School of Hygiene and Public Health, University of Pennsylvania.

October 22. "The organization of community anti-tuberculosis work." G. T. Drolet, Statistician, N. Y. Tuberculosis Commission.

October 29. "The sanitary control of food and drink in Philadelphia." Professor Seneca Egbert, School of Hygiene and Public Health, University of Pennsylvania.

November 5. "The anti-venereal campaign." T. C. Funck, Pennsylvania Department of Health.

November 12. "Social service as a factor in public health activities." Dr. H. R. M. Landis, director of the Clinical and Sociological Department, Henry Phipps Institute.

November 19. "Infective diseases not caused by bacteria, their nature, spread and suppression." Professor A. J. Smith, professor of pathology, University of Pennsylvania.

November 26. "The administration of public health laboratories." Dr. John Laird, director of the laboratory of Pennsylvania State Department of Health.

December 3. "Medical examination and classification of workmen as complementing the sanitary supervision of workplace." Dr. Frank Craig, Henry Phipps Institute.

December 10. "The limitations of Eugenics." By Professor C. E. McClung, professor of zoology and director of the laboratory of zoology, University of Pennsylvania.

December 19. "On the training of public

health officials and the opportunities for using such training." Dr. John A. Ferrell, International Health Board, Rockefeller Foundation.

THE LANE MEDICAL LECTURES OF STANFORD UNIVERSITY

Dr. L. Emmett Holt, emeritus professor of pediatrics of the College of Physicians and Surgeons of Columbia University, will deliver the Lane Medical Lectures in the Stanford University Medical School, San Francisco, from December 5 to 10. The lectures will take place daily at 8 P. M. The topics will be as follows:

I. The general subject of nutrition—its importance in relation to health and growth, to progress in school, to resistance to infection and in the management of acute and chronic disease.
II. The food requirements of the healthy child after infancy.
III. The function in diet of fat, protein, carbohydrate and mineral salts, and the conditions which determine the amounts needed.
IV. Vitamines—Their function in nutrition and the new point of view which they have given regarding food values.
V. The practical problem of improving the nutrition of children including the prevention and treatment of malnutrition.

Dr. Holt will also give a clinic on children's diseases on Wednesday, December 7, at 11:30 A.M., at the Medical School.

THE TORONTO MEETING OF THE AMERICAN SOCIETY OF NATURALISTS

The thirty-ninth annual meeting of the American Society of Naturalists will be held in Toronto, Canada, on Thursday, December 29, 1921, under the auspices of the University of Toronto.

Headquarters of the society will be the King Edward Hotel, 37–55 East King Street, where the American Society of Zoologists and the Botanical Society of America will also have headquarters. Members desiring accommodations at headquarters should make reservations early. Accommodations may also be obtained at other hotels and probably also at the dormitories of the university and near-by fraternity houses. Information concerning these accommodations will be given later in Science or in the final announcement in December.

On Thursday forenoon a limited number of short papers by members and invited guests will be given. Members desiring to present papers should send the titles to the secretary not later than November 24, giving estimated time of delivery, and requirements of lantern, charts, blackboard space, etc. It should be remembered that the primary interest of the society, as expressed in resolutions, is in evolution in its broadest sense.

Thursday afternoon is to be devoted to the annual symposium. The general subject in 1921 is "The Origin of Variations," and the following speakers have been secured:

H. S. Jennings—Variation in Uniparental Reproduction.

A. F. Blakeslee—Variations in Datura due to Changes in Chromosome Number.

H. J. Muller—Variation due to Change in Individual Genes.

C. B. Bridges—The Origin of Variations in Sexual and Sex-Limited Characters.

R. A. Emerson—The Nature of Bud Variations as Indicated by the Mode of their Inheritance.

M. F. Guyer—Serological Reactions as a Probable Cause of Variations.

The naturalists' dinner will be given on Thursday evening. The annual address of the president will follow.

The American Association and most of the affiliated societies will meet in Toronto. Attention is called to cooperation of the naturalists with the Botanical Society of America and the American Society of Zoologists, whereby the latter two societies list their papers on subjects of greatest interest to the naturalists on the day preceding the naturalists' program.

Section G (Botany) of the American Association will present on Wednesday afternoon a symposium on the "Utility of the Species Concept," in which the speakers are Charles F. Millspaugh, George H. Shull, R. A. Harper, Guilford B. Reed, and E. C. Stakman.

The American Society of Zoologists has ar-

ranged a symposium on "Orthogenesis," to be participated in by L. J. Henderson, C. B. Lipman, M. F. Guyer, William Bateson, W. M. Wheeler and H. F. Osborn. This symposium will be given on Friday, possibly beginning in the forenoon.

A. Franklin Shull, *Secretary*
University of Michigan,
Ann Arbor, Michigan

SCIENTIFIC NOTES AND NEWS

Dr. Harlow Shapley, formerly of the Mount Wilson Solar Observatory, has been appointed director of the Harvard College Observatory in succession to the late Edward C. Pickering.

Dr. Joel Stebbins has been appointed director of the Washburn Observatory and professor of astronomy at the University of Wisconsin, beginning on July 1, 1922, to succeed Professor George C. Comstock, who has been director of the observatory since 1889 and has reached the age of retirement. Professor Comstock will carry on his work as director of the observatory during the present academic year, while Dr. Stebbins will act as non-resident professor of astronomy. Dr. Stebbins has been a member of the department of astronomy at the University of Illinois since 1903 and director of the observatory since 1913. Professor Comstock has been a member of the Wisconsin faculty since 1887 and, besides being director of Washburn Observatory for 32 years, was dean of the Wisconsin Graduate School from 1906 to 1920.

Dr. Edgar F. Smith, provost emeritus of the University of Pennsylvania, has been elected an honorary member of the French Society of Chemical Industry, and also an honorary member of the Chemical, Metallurgical and Mining Society of South Africa.

Wilfrid Kilian, professor of geology in the University of Grenoble in the Dauphiné, France, has been awarded the Gaudry gold medal, the highest distinction of the Société Geologique de France.

At the opening of the annual meeting of the French Society of Chemical Industry on October 10, the Dumas medal of the society and an illuminated address were presented by M. Dior, minister of commerce, to Sir William J. Pope.

Dr. Hiko Matsumoto, who until a few weeks ago was studying the Fayûm collection of Proboscidea in the American Museum, recently received the prize of the Imperial Institution of Science and Literature of Japan.

The French Geological Society met, from September 14 to 20, in Savoie, under the presidency of M. G. Révil and with the assistance of MM. Morel, Le Roux and Kilian. A number of excursions were made.

At its 1921 meeting in New Orleans, the American Pharmaceutical Association awarded the 1921–22 grant from the A.Ph.A. Research Fund to Dr. David I. Macht, of Johns Hopkins University, for pharmacological work on the benzyl compounds found in certain galenicals. The first grant made in 1919 was awarded to Dr. George D. Beal, of the University of Illinois, for work on alkaloidal assays, while the 1920 award was made jointly to Dr. Heber W. Youngken, of the Philadelphia College of Pharmacy and Sciences, for work on aconite varieties and Dr. E. Kremers and Miss Lila Winkelblech, of the school of pharmacy of the University of Wisconsin, for work on derivatives of guaiacol.

Dr. Kirtley F. Mather, professor of geology at Denison University, Granville, Ohio, lectured before the Geographical Society of Chicago on October 28. His subject was "Andine trails and jungle streams, the search for oil in Bolivia." Dr. Mather spent the greater part of the year 1920 in exploration along the eastern front of the Andes in the central portion of South America. On his return he resumed his work at Denison University.

Professor E. J. Cohen, of the University of Utrecht, Holland, was at the Ohio State University for nine days in the early part of October. During this time he delivered three lectures on piezochemistry, two on the

metastability of matter and one on scientific work and education in Holland.

The Thomas Hawksley lecture of the Institution of Mechanical Engineers for the present year was delivered on November 4, by Dr. H. S. Hele-Shaw, who took as his subject "Power Transmission by Oil."

Dr. Julius Hahn, the distinguished meteorologist, long professor at the University of Vienna, died on October 13, at the age of eighty-two years.

The death is announced of Sir William Edward Garforth, known for his pioneer work in connection with safety in coal mines.

A course of lectures and discussions on problems of public health in relation to industrial hygiene will be delivered in the lecture theater of the Royal Institute of Public Health, London, on Wednesdays from October 19 to December 7, 1921.

The Imperial College of Science and Technology, South Kensington, London, with which the Royal School of Mines is incorporated, is offering two research fellowships of £300 a year each, tenable for one year, and possibly renewable for a second year, to aid in carrying out an investigation connected with mining, mining geology, metallurgy, or the technology of oil, which in the opinion of the committee is of sufficient use or promise.

The Board of Regents of the University of Michigan has established two fellowships for graduate students in the Museum of Zoology. These will be known as the Edward C. Hinsdale fellowships, and will be supported by a fund bequeathed to the university by the late Genevieve S. Hinsdale, of Detroit.

Under the directorship of Professor Frank Schlesinger, the Yale University Observatory has been opened to the public on two nights of each week, and one of the domes and telescopes has been fitted up for this purpose. To make use of these facilities, one must write to the director some weeks in advance, enclosing a self-addressed envelope, indicating the preferred date and stating how many there will be in the party. Tickets will then be forwarded, which are valid for that night.

Steps toward the expansion of research work at the Pennsylvania State College were taken at the recent conferences held at the college on the occasion of the inauguration of President John M. Thomas. Resolutions calling for the appointment of a general committee to investigate agricultural research at the college and to recommend future work and its support, were adopted at the agricultural conference. Action taken at the conference for state leaders in the mining, metallurgical and ceramic industries approved the fostering of research work in those lines at the college school of mines. It was the recommendation of each conference that sufficient research funds should be provided by the state legislature in the interest of the people of the state.

Medical treatment by specialists for persons of moderate means is now given at fees which cover merely the cost of service, with the opening on November 1 of a model "pay clinic" at Cornell University Medical College. The clinic, the first of its kind to offer general medical service in New York City, is designed to meet the needs of persons unable to pay high specialists' fees, but who, because they are not paupers, are unable to enjoy the advantages of the charity clinics. The pay clinic will occupy three floors in the wing of the college building formerly occupied by the dispensary. It will be open every afternoon from 1.30 until 4 o'clock, except Sundays and holidays. To serve those who can not afford absence from work in the afternoons, evening clinics will also be open on Tuesdays and Fridays until seven o'clock. The clinics will be under the direction of the Cornell medical faculty. Physicians in the pay clinic will be salaried and every effort will be made to preserve the atmosphere of dignity, privacy and consideration for patients, and the same feeling of personal relationship between physician and patient that characterize private practise. The scientific equipment of the college, its laboratories and x-ray facilities will all be used. The rates for treatment will be as follows: Each visit for examination and

treatment, $1; medicine, laboratory tests, x-ray photographs and other supplies at cost; diagnosis of cases requiring special examinations and study, with group consultation of specialists and diagnosis, $10; thorough health examination to discover possible defects from diseases and to obtain advice regarding personal hygiene, $2.50.

The next meeting of the International Geodetic and Geophysical Union and of its various sections will be at Rome in 1922.

UNIVERSITY AND EDUCATIONAL NEWS

Under the terms of the will of the late Hiram Francis Mills, A.M. (Hon.) '89, of Hingham, $200,000 has been left to Harvard University for the study of the origin and cure of cancer. The fund is to be known as the Elizabeth Worcester Mills Fund in honor of Mr. Mills's wife.

On account of the increased enrollment in psychology courses in Purdue University, two additional instructors and an assistant have been appointed. The new instructors are: H. C. Townley, A.M. (Wisconsin '21), Peter McCoy, A.M. (Columbia '14), and Dorothy Lee, A.B. (Indiana '21). The present enrollment in general and vocational psychology is approximately 500, of whom 345 are men. Changes in the engineering curricula at Purdue make it possible for an engineering student to take two full years of work in psychology.

At the University of Pennsylvania in the Medical School, Dr. Glen E. Cullen has been made an associate professor of research medicine. Dr. W. A. Jaquette has been made professor of oral surgery and director of the school of dental hygienists, and Dr. Samuel Goldschmidt has been made assistant professor of physiology.

Three associate professors in the Towne Scientific School have been promoted to full professorships in chemistry. They are Dr. John Frazer, Dean of the Towne Scientific School; Dr. Thomas P. McCutcheon and Dr. Hiram S. Lukens. The trustees have also elected Dr. George A. Piersol emeritus professor of anatomy. Dr. Piersol retired from the professorship of anatomy last spring.

Welton J. Crook has resigned as chief metallurgist to the Pacific Coast Steel Co. to accept an appointment as associate professor of metallurgy in Stanford University.

Miss Emma Francis, who resigned as head of the nutrition laboratory, Battle Creek Sanitarium, last July, has been appointed assistant professor of chemical agriculture in the Experiment Station of Pennsylvania State College.

Kenneth H. Donaldson has been appointed instructor in ore dressing and mining at the Case School of Applied Science.

Professor F. E. Guyton, of the Ohio State University, has been appointed assistant professor of zoology and entomology at the Alabama Polytechnic Institute.

E. Eugene Barker has returned from Porto Rico and has accepted a position as associate professor of botany at the University of Georgia.

J. J. O'Neil has been appointed acting assistant professor of geology at McGill University during the absence of J. A. Bancroft.

DISCUSSION AND CORRESPONDENCE

AN EXPLANATION OF LIESEGANG'S RINGS

To the Editor of Science: Dr. McGuigan seems to be unaware of much recent work on banded precipitates (Science, July 22). He has come to the conclusion, generally, that in some way, the chromate is attracted from the regions of the gel adjacent to the precipitate. So far this is in accordance with the theory proposed by myself in 1916 and confirmed by a long series of experiments.[1] But Dr. McGuigan's particular hypothesis will not bear examination in detail. He may be right in supposing the attractive force to be that between the silver and chromate ions. But this is not sufficient to explain why the bands form in gelatin and not in agar. Neither is the assumption tenable that the

[1] *Biochem. J.*, 1916, X., 169; 1917, XI., 14; 1920, XIV., 29, 474.

chromate of itself is unable to diffuse in the gelatin. The contrary is easily proved. Moreover, there are a great many precipitates that give bands either in gelatin, agar, silicic acid or even in filter paper and sand. It can not be assumed, in every case, that one of the reagents is fixed. Further, the facts quoted by Dr. McGuigan in support of his hypothesis are inaccurate. Bands of lead chromate can be obtained in gelatin with the right concentrations of lead acetate and potassium dichromate, as also with silver nitrate in the gel and the dichromate in aqueous solution.

Examination of a great many different kinds of precipitate in gels and other media shows that band formation occurs only when the precipitate is extremely finely divided, or, practically, in the colloid state. If the specific surface of the precipitate is insufficient there is no banding. The experiments are made conveniently in test-tubes half filled with gel on which the liquid reagent is poured. As the specific surface increases, at first, bands of denser precipitate are formed in a diffuse column of precipitate extending down the tube. With further increase of specific surface, the bands become more marked, until, eventually, there may be no precipitate between. The formation of bands in a diffuse precipitate absolutely disproves the "supersaturation" theory.

The attractive force, the effect of which is well illustrated in Dr. McGuigan's photograph, is that of adsorption. When the precipitate is sufficiently finely divided it adsorbs the solute from the adjacent zone of gel. More solute diffuses into this zone from the regions of gel more remote, where the concentration of solute has not been diminished. But the solute is adsorbed as fast as it arrives in the neighborhood of the precipitate and is removed from solution by the excess of precipitating reagent. Thus a concentration gradient is set up towards the precipitate, and a considerable region of gel adjacent to the precipitate becomes practically devoid of solute. If the rate of diffusion into the gel of the stronger reagent is sufficient, this reagent will be able to travel through the exhausted zone until it reaches a further region of gel where there is sufficient solute to form another band of precipitate. The increasing distances apart of the bands are due to the diminishing concentrations both of the solute in the gel and of the reagent diffusing in.

The specific surface of the precipitate is influenced by the concentrations of the reaction components, by the nature of the reaction medium and by the presence of electrolytes. Generally, it is determined by the value of N in von Weimarn's somewhat indefinite formula

$$N = K . (P/L),$$

where P is the excess concentration of the substance to be precipitated, L its solubility and K is a factor representing the viscosity of the reaction medium and the physical and chemical complexity of the reaction components in solution. The formula is being investigated further. But it has been shown that the occurrence or non-occurrence, of bands of a given substance in different gels is due to the influence of the reaction medium, and that, by varying its specific surface, a substance can be obtained in the banded form, or not, as desired. For instance, silver chromate and dichromate form bands in gelatin. In agar gel they occur as black ribbon-like crystals up to several centimeters in length. By increasing the specific surface of the precipitate in agar, both salts have been obtained in a banded form even more beautiful than in gelatin.

S. C. Bradford

The Science Museum,
South Kensington,
London, S. W.,

SPECIALIZATION IN THE TEACHING OF SCIENCE

To the Editor of Science: It is somewhat amusing to note Professor Gortner's reference to the settee of science as if it were a thing of the past, and then to find, on an earlier page of the same issue, an advertisement which calls for a professor of zoology and geology.

As a matter of fact, it would not be difficult to find scores of just such mixed professorships and instructorships in colleges all over this country. I think it would be safe to assert that it is only in the larger universities, relatively few in number, that specialization has been carried to anything like the degree suggested.

The cases of the colleges in this state may be cited as examples. In one, geology is taught by a professor of astronomy, in another by a professor of agricultural chemistry; in a third a professor of chemistry teaches mineralogy. And it is only fair to these several professors to say that in each case the instruction given is excellent.

That Maine is not unique in this respect is indicated by notices of vacancies in college faculties that have come to my attention during the past two years. In one case an instructor was needed in chemistry and geology, in another an associate professor in zoology and geology, in colleges one of which was near the Atlantic coast (not in Maine), and the other not far from the Pacific.

In my own teaching experience I held for a number of years a position in which I was expected, and did make a brave attempt, to teach chemistry, geology, botany and zoology, with a little physics thrown in for good measure; this in an institution which would be called a college almost anywhere outside of New England.

There are potent reasons why this condition of affairs exists still, and must go on existing for some time to come, whatever may be said as to its desirability; the most obvious being the limitations placed upon our colleges by lack of money. However, I am not altogether certain that the condition is undesirable.

I realize, of course, that Professor Gortner and I are not thinking of exactly the same thing. His attention is, naturally, on the more advanced courses, in which students are, and should be, in charge of more or less narrow (I use the word in no derogatory sense) specialists; mine is on the more general courses, in the conduct of which teaching ability and personality are at least as important as erudition. There is still a large and important field for the old natural-history type of instructor, and I for one sincerely hope that his species will not soon become extinct.

FREEMAN F. BURR
CENTRAL MAINE POWER COMPANY,
AUGUSTA

SHARK AND REMORA

TO THE EDITOR OF SCIENCE: The account by Dr. Spaeth in SCIENCE of October 21 of symbiotic relations between a shark and a remora recalls some observations made by the writer in San Diego, Cal., in November, 1920. The head of a Tuna Shark, *Isuropsis glauca,* had been cut off by the writer and carried to the laboratory of the Scripps Institution, at La Jolla. After some dissections had been made there was found on the table a small remora, three inches long, that had evidently taken refuge in the mouth or gill-chamber of the shark.

H. W. NORRIS
GRINNELL COLLEGE

SCIENTIFIC BOOKS

Life of Alfred Newton, Professor of Comparative Anatomy, Cambridge University, 1866–1907. By A. F. R. WOLLASTON. With a preface by SIR ARCHIBALD GEIKIE. New York: E. P. Dutton & Co., 1921. 332 pp.

The loose organization of English University affairs, the lack of coherence in the scheme of the institutions, have had their advantages and disadvantages. When in Cambridge a number of years ago, I met an eminent writer whose original and heterodox ideas about religion had lately been published in a book. "What do the orthodox divines of the University think of him?" I asked a resident. "They do not even know that he exists!" Perhaps that was a slight exaggeration, but the independence of the teachers is such that they do very nearly as they please, and wax or wane in reputation and even income according to their ability to command attention or win support. The centrifugal tendency has dominated the intellectual life of the place, increasing with the inevitable specialization of modern times. Each department is, as it were, at the end of a long lane, which no one

cares to explore unless particular business calls him.

We are now awaiting the report of the recent Government Commission, which visited Oxford and Cambridge during the last year. As a result of the war, or perhaps we should say of a necessary process hastened by the war, the ancient universities need government support. With support must go responsibility of a new kind, and possibly some sort of unification of the system. Is it possible that definite standards of equipment and teaching will eventually be required, enforced through some process of inspection? These are weighty matters for us here in America, for in many places we stand at the parting of the ways. The old freedom is difficult to maintain in the presence of a population requiring to be educated *en masse*. It matters too much if things are badly or wrongly done. At all hazards, we must maintain our intellectual integrity, but we necessarily sacrifice something of our independence. Does that mean that the best minds will gradually be robbed of their originality, grown prematurely inelastic and old? England, the home of the independent worker, has produced more original thinkers than America, whether we consider the sciences or the arts.

There is another and opposite side to the picture. The strong individuality of the leading English scientific men has had a profound influence on their colleagues, and this has been accentuated by the smallness of the country and consequent ease of communication. Professor Alfred Newton, whose teaching in certain of its aspects seemed so amazingly inadequate, was a very center of light and learning for an ardent group of ornithologists, through whom his influence radiates to this day. His "Dictionary of Birds" has no real competitor, and is one of the indispensable books to students of the subject. Throughout the Biography, here and there, we find a note of half regret that the Professor was so set in his ways, so peculiar, so amazingly conservative. Yet perhaps had he not developed freely in his own manner, his power would not have been so great. His old friend Dr. Guillemard thus sums up his impressions:

> Such strength of individuality I can not recall in any other person I have known. It can safely be said that, having carefully envisaged his question and decided it, no human power could make him alter his mind. Yet one almost hesitates to say it, lest a wrong impression should be conveyed, for he was one of the most lovable of men, and inspired an unusual degree of personal affection in the many young men who frequented his rooms. The influence he exercised upon them was remarkable, not only upon the ornithologists, but upon men like Adam Sedgwick, Bateson, Frank Darwin, Lydekker, and a host of others in different fields. It would, I think, be correct to describe him as the founder of the modern Cambridge scientific school, developing the good seed sown by Henslow, who was to a former generation, I imagine, very much what Newton was to mine.

The statement about the modern scientific school applies of course only to the biological, or more specifically zoological, field. Even in the field of zoology Newton's knowledge was quite limited, but it was extraordinarily exact. His interest in birds was so wide that it led him into various fields, as for instance that of philology. Thus he combined what might be considered narrowness with a remarkable breadth of view, which undoubtedly added greatly to his beneficial influence on his students.

Sir Arthur Shipley, who was a student under Newton, gives a lively account of his lectures:

> Newton's lectures were desperately dry and very formal. The Professor sat before a reading desk and read every word of the discourse from a written manuscript, written in his minute hand with a broad quill, so that all the letters looked the same, like the Burmese script. At long intervals there was drawn the outline of a tumbler. Whenever the Professor came to these outlines he religiously took a sip of water. Whether it was the time of day [1 p. m.] or whether it was that we students were all absorbed in comparative embryology and in morphology, the attendance was always small. I went during my second and third year, and at times was the sole auditor. Not that that made the least difference to the Professor. He steadily and relentlessly read on—"the majority of you now present know," "most of my audience are well aware," and similar phrases left me in considerable doubt

as to what parts of me were "the majority" and which the "most."

About the year 1884, Newton prepared courses of lectures on Geographical Distribution and Evidences of Evolution. He was to lecture on Monday, Wednesday and Friday at noon. He discovered, however, that the lectures, as written, would not stretch over a whole term, so he told the class that next Monday he would unfortunately not be able to lecture owing to urgent business, and this would continue throughout the term.

Dr. Guillemard, in the passage quoted above, has referred to the difficulty of changing Newton's well-considered opinions. It must be added, however, that he was able to keep an open mind on certain subjects of great importance to him. Thus he readily appreciated Darwin's theory at the time of its publication, and only four days after the publication of the Darwin and Wallace papers by the Linnean Society wrote a long letter on the subject to Canon H. B. Tristram. This led to the circumstance that Tristram was the first zoologist of note to publish his adherence to the doctrine, though unfortunately he was reconverted to the old faith shortly after. He also came to see that the old classification of birds was faulty, and recognized the necessity for fundamental revision.

Professor Newton was an ardent field naturalist, and in his earlier days visited the West Indies (St. Croix and St. Thomas), Iceland, Spitzbergen and other countries, always making interesting observations. He did his best to discover the haunts of the great Auk in Iceland, but although he talked with men who had seen it, it was apparently extinct before his visit. He left copious materials for a history of the great Auk, which he intended to publish had his life been prolonged a few more years.

Newton died in 1907, his last wish being "may the study of zoology continue to flourish in the University." Since then, much good and important work has been done, but there is great need for more room, more assistance, more apparatus, and adequate salaries for the staff. The whole British Empire is concerned in this matter, for in such centers must be trained the men who go out to solve the innumerable problems of the dominions and colonies. Nor is it merely a matter of training specialists, for modern life requires that the leaders in all fields shall know something of biology. Thus, even if conditions in Newton's time could have been described as adequate (which they were not), they would no longer suffice for modern needs.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

ACOUSTICAL NOTES

Musical Notation.—The recent interesting letter in SCIENCE describing a new musical notation and proposing a new keyboard therefor, calls for a brief historical note, even though it should make two ingenious gentlemen "curse those who said our good things before us."

It is obviously true that the staff which best conforms to our chromatic scale of twelve equal steps to the octave, and best appeals to the mind accustomed to grapho, is one of 12 (13) equally spaced lines for an octave; or since it is difficult to distinguish among so many lines alternate lines may be omitted so leaving a 6-line or whole-tone scale. These facts are so obvious that both forms have been invented repeatedly, as is shown by patents long since expired. The earliest use found was by Joshua Steele in "Melody in speech," London, 1775. To distinguish between the numerous lines he superposed the ordinary five lines and used some dotted lines. For many years I have found this notation very convenient for writing non-harmonic scales or music and have referred to it occasionally in print, but it seems never to have appealed to musicians.

Modifications of this many-lined staff have been proposed; one uses only four or three lines, but any note, as C, will come in the same position in all octaves; sometimes the note-heads are of different shapes. The most frequent modification is to retain only the five lines that correspond to the black keys of the piano—a scheme closely analogous in principle to the old tablatures. This was

advocated by Busoni who published a few pages of music written on what may be called the "black key staff."

Corresponding to the whole-tone staff the very logical whole-tone keyboard has likewise been proposed by several patentees and is most notably found in the Janko keyboard; this had considerable vogue in Germany and a few were built in this country some twenty years ago; but the instruments with this keyboard are so rare that the musician could scarcely afford the time to practise on it if he had access to one.

A Question of Tuning.—One of the musical trade papers reported some months ago that a phonograph dealer in Chicago had two similar pianos tuned alike, except that in one of them one string belonging to each set of these unisons was tuned to give a slow beat with the other two. Then the public was asked which tuning it preferred; a large majority chose the one with the beat. This preference quite disconcerted the editor who reported it; "What is the use," he says, "of trying to keep a piano in tune when a mistuned one is really liked better?"

This does not seem to me to involve the question of being out of tune in the ordinary meaning of the term; if a chord is struck two thirds of the strings will sound together in the usual way, though the accuracy of tuning will be somewhat blurred or masked by the beats due to the other strings.

But a similar even more marked effect has long been obtained in other ways and has often been proposed by inventors. It is akin to the tremolo which is familiar as a means of expression on many instruments and which in vocal music may be a sign of emotion or even weakness. On the violin a tremolo may come from the rolling of the player's finger along the string, and on mechanical violins from intermittent pressure on the tail piece. Even more closely analogous to the effect in the piano experiment and long known are the results of the "Celeste" stop on the reed organ that brings into use two sets of reeds which beat slightly with one another; and in the pipe organ of the "Vox Celeste" or "Unda Maris" stop that brings on two sets of pipes which beat producing a very few waves per second.

So the Chicago experiments seem to me to indicate, not that hearers object to having the notes of the piano in tune, but that they welcome a new way of introducing variety, vitality, into piano tone. After the key is struck there comes the loud thud characteristic of the piano sound and then the gradual dying away of the sound; the musician can do nothing with the tone but let it die away till he is ready to drop the damper. The player of most other instruments has considerable control over the loudness of a continued sound and occasionally to some extent over its pitch and quality; this is obviously true of most orchestral instruments, and of the organ with its swell and the harmonium with its "expression" due to pumping.

This double control, of loudness and pitch, was realized in the old clavichord and was sought for in the "Steinertone" patented and built by the late Morris Steinert fifteen or twenty years ago. I have recently learned from the makers that in the reproductions built some years ago by Chickering & Sons under direction of Mr. Dolmetsch "the clavichord was tuned with one string of each note two or three waves sharper than the others, and on the harpsichord the second unison was slightly sharper than the first." In the electrical "Choralcelo" exhibited in Boston some years ago there was control both of loudness and quality while a note was sounding.

So the Chicago experimenters and listeners are in good company.

Of course the piano must have some great compensating advantages to lead the world to overlook so great a defect as this lack of variety, but they do not concern us now or here.

The Tuning Fork.—In a recent article in a psychological journal the tuning fork is considered as composed of two bars each attached at one end to a solid block; in a current book for piano tuners a fork is illustrated as sending off a train of waves in one direction, both prongs being bent in the same direc-

tion. These surprising disclosures led to an examination of a number of text-books, etc., on sound, from which it appeared that only rarely was there any reference to the true theory of the fork; even the Britannica supports the view of the psychologist. So a note on the subject may not be superfluous.

The theory of the fork is due to Chladni's researches of a century ago. He had found that a horizontal straight uniform bar could vibrate when supported at points about 0.22 of its length from the ends; obviously portions each side of these nodal points must at any instant be moving in opposite directions. Then he bent the bar a little and found that the nodes had moved toward the center, and when the fork-shape with long parallel prongs was reached, the nodes were near the base of the prongs. Assuming the prongs vertical, when they separated the intermediate part near the bends would of course rise a minute distance. In any practical case the center portion is loaded by the stem which will therefore move up and down and deliver regular blows to a sounding board or resonance box on which it may be placed. Such an effect can not be accounted for by the crude theory that prompted this note.

It will help to clear thinking to recall the curious fork shown by the Standard Scientific Co. at the exhibit of apparatus at the Bureau of Standards about a year ago. This had a relatively large hole near the upper end of the stem, the effect of which was to make the pitch much lower than that of a similar fork unperforated.

In this connection it may be added that measures I made some years ago showed that a Koenig's fork of the middle octave on its box, when vibrating at an average amplitude, expended its energy at the rate of about one millionth of a horse power or less than a thousandth of a watt; of course only a small part of this produces sound and only a very minute fraction of this part could reach the ear of any one of the hundred who could hear the fork.

CHARLES K. WEAD

ANN ARBOR, MICH.

SPECIAL ARTICLES

THE RELATION OF SOIL FERTILITY TO VITAMINE CONTENT OF GRAIN[1]

THIS study was undertaken at the suggestion of Professor F. J. Alway, who has made a study of the relation of phosphate-hungry peat soils to the grain produced on them,[2] at Golden Valley, Minn.

Burning of the peat rendered mineral matter more available to the plant and increased the yield. It also increased the amount of phosphoric acid in the grain and, as we shall show, increased the vitamine. Two experiments were made, one with barley grown on untreated and on burned peat, and another on oats grown on peat soil as contrasted with ordinary mineral soil. The barley grown on untreated peat yielded 7.4 bushels per acre and the grain contained 0.5 per cent. P_2O_5 in the dry matter, or 17.9 per cent. in the ash, whereas the barley grown on burned peat yielded 42.6 bushels per acre and contained 1.06 per cent. P_2O_5 in the dry matter and 35.5 per cent. in the ash. The oats grown on untreated peat soil contained 0.52 per cent. P_2O_5 in the dry matter and 17.9 per cent. in the ash. The oats grown on ordinary mineral soil in the same locality contained 1.1 per cent. P_2O_5 in the dry matter and 32.4 per cent. in the ash. It was at first attempted to determine the vitamine content of these grains by the quantity necessary to prevent or cure polyneuritis in pigeons. It was very difficult, however, to feed these grains quantitatively to these pigeons, and they all died of polyneuritis before the end of the experiment.

The next attempt was to feed the whole grains quantitatively to white rats, but this method failed also.

The next method was to grind the grains and mix them to the extent of 5 per cent. in a

[1] Contribution from the laboratory of physiological chemistry, University of Minnesota Medical School.

[2] F. J. Alway, "A phosphate-hungry peat soil," *Journal of the American Peat Society*, Vol. 8, 1920.

basic ration made of 10 per cent. pure casein, 6 per cent. sea salt and 84 per cent. white flour. The rats were allowed to eat this *ad libitum* and were supplied with ordinary tap water in addition. At the end of the thirty-second day butter fat was added to the ration to the extent of 1 gram per rat per day. The experiment lasted 65 days. In the above experiment, two rats, both males and weighing 65 grams each, and of the same litter, were taken and fed this diet. At the end of the 65 days the rat getting the barley with 0.5 per cent. P_2O_5 weighed 108 grams, whereas the one getting barley containing 1.06 per cent. P_2O_5 weighed 117 grams. This difference of 9 grams is small, and yet, owing to the exact manner in which the experiment was performed and the fact that the rats were of the same sex, size and litter, this small difference is significant.

In the experiment with oats two female rats of the same litter were taken. These rats were practically the same weight. In fact they were of exactly the same weight (55 grams) on the second day of the experiment. At the end of 65 days the rat receiving oats with 0.53 per cent. P_2O_5 weighed 86 grams and the rat receiving oats containing 1.1 per cent. P_2O_5 weighed 97 grams. It may be remarked that the experiments with female rats are not always quite as uniform as those with male rats, but these female rats showed no peculiarities in the growth curves. These experiments are in harmony with those of a number of workers and show that the vitamine content of *milled grains* is proportional to the content in P_2O_5. In the case of milled grains, however, the variation in P_2O_5 is due to its partial removal in milling, whereas in experiments recorded in the present paper the variation is due to the amount of available phosphoric acid in the soil. Since butter fat was fed uniformly throughout the last half of the experiment, the difference in growth of the rats is due to difference in vitamine *B*.

J. F. McClendon,
A. C. Henry

University of Minnesota

MOLD HYPHÆ IN SUGAR AND SOIL COMPARED WITH ROOT HAIRS

To compare sugar with soil as a place for growing molds may at first sight be revolutionary, but to one who has studied molds in soil, the first glimpse of a moldy sample of sugar under the microscope compels the comparison put forward in the title of this paper. Mold hyphæ as seen in foods such as sugar and in soil strikingly resemble root-hairs as they develop in earth. Hyphæ of fungi and root-hairs are analogous structures. Both belong to the vegetative phase of a plant's life cycle. Both are turgid, thin-walled cells. The elongating hypha pushes itself between sugar crystals or between soil particles in the same fashion as the elongating root-hair progresses in the soil. The elongating hypha, like the root-hair, is a feeding and growing portion of a plant, which is submerged in a substratum. The hyphal tip, as is commonly understood of the apex of a root-hair, follows between the sugar crystals or soil particles along the path offering the fewest obstacles. Such a path or course is at best winding, irregular, now wide and again extremely narrow. The mold hypha under suitable conditions grows between the faces of the sugar crystals or soil particles. As would the root-hair, it forces its way into a narrow passage, its shape conforming to the space discovered. There may be a bulge on one surface of the hypha and a flattened area on the opposite surface, all depending on the space available for expansion. Attracted by the films of water and available solutes adhering to the sugar crystal or to the soil particle, the mold hypha grows over the face of a particle, conforming to the irregularities in the surface of the object.

It is impossible to separate these bits of mold hyphæ from the respective sugar crystals or soil particles in conjunction with which they are growing. It is commonly known that a separation of soil particles from root hairs, which are much grosser units than segments of mold hyphæ, is impossible without injury to the root-hairs.

To one familiar alone with the easily studied and regular structure of a root-hair developed in a moist chamber, the root-hair as it grows in the soil is not recognizable except as it is traced to its point of attachment among the other epidermal cells of the root. Parallel to this statement it may be said that to one familiar alone with mold hyphæ as they may develop with freedom in liquid or solid culture media such as agar or gelatine, the mold hyphæ growing under natural conditions among sugar crystals or between soil particles are totally unrecognizable, neglected and passed over. No suitable bacteriological methods of making dry smears or stained preparations have yet been devised for demonstrating molds in such situations. These mold hyphæ are enough larger than minute bacteria to be plasmolyzed and for their structure to be dried out beyond recognition by this exceedingly harsh treatment. The best of objectives with high magnifications are required to demonstrate this close relation of mold hyphæ either to sugar crystals or to soil particles. For this an oil immersion objective must have a long working distance to permit a mount as thick as a sugar crystal or soil particle to be examined with the mold hyphæ attached. This has been possible with such a combination as a Zeiss 3 mm. N. A. 1.30 apochromatic objective and a 12 X compens. ocular. Few other available combinations will give the necessary clarity of field, magnification and working distance to demonstrate the intimate relationship existing between the mycelium of saprophytic molds and certain substrata.

This intimate relationship between mold hyphæ and the substratum explains why many have overlooked active growths of molds in the soil and others have denied it. It explains also in part the spoilage of certain foodstuffs such as sugar. Much damage can undoubtedly take place without macroscopic evidence of mold. Mold hyphæ have just such an intimate relationship to sugar crystals or soil particles as is well known to exist between root hairs of higher plants and the soil particles of the ground wherein they grow.

MARGARET B. CHURCH,
CHARLES THOM

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF ORGANIC CHEMISTRY

Roger Adams, chairman.

H. T. Clarke, secretary.

Oximes: F. W. ATACK.

Organo tellurium bases: A. LOWRY AND R. F. DUNBROOK. Aromatic bases and $TeBr_4$ react in ether or acetic acid solution to produce organo tellurium bases. The following complexes have been prepared and analyzed:

$(C_6H_5NH_2)_2 . TeBr_4$
= Bi-aniline tellurium tetrabromide,
$[C_6H_5N(CH_3)_2]_2 . TeBr_4$
= Bi-dimethylaniline tellurium tetrabromide,
$(\beta\text{-}C_{10}H_7NH_2)_2 . TeBr_4$
= Bi-β-naphthylamine tellurium tetrabromide,
$p\text{-}C_6H_4(NH_2)_2 . TeBr_4$
= p-phenylenediamine tellurium tetrabromide,
$m\text{-}C_7H_6(NH_2)_2 . TeBr_4$
= m-toluylenediamine tellurium tetrabromide,
$(p\text{-}BrC_6H_4NH_2)_2 . TeBr_4$
= Bi-p-bromoaniline tellurium tetrabromide,
$[(C_6H_5)_2NH]_2 . TeBr_4$
= Bi-diphenylamine tellurium tetrabromide,
$H_2NC_3H_4 . C_6H_4 . NH_2 . TeBr_4$
= Benzidine tellurium tetrabromide,
$[(CH_3)_2N . C_6H_4]_2CH_2 . TeBr_4$
= Tetramethyl-diamino-diphenyl-methane tellurium tetrabromide.

Alkaloids also produce complexes with $Tebr_4$.

The rôle of acetic acid and ammonia as catalysts in the formation of acetamide from ammonia acetate: W. A. NOYES AND WALTHER GOEBEL. Dr. M. A. Rosanoff showed several years ago that acetamide may be prepared at atmospheric pressure by heating ammonium acetate with an excess of glacial acetic acid. He considered that the acetic acid is a catalytic agent but, as he worked under conditions such that the water formed distilled away, he did not actually prove whether the acetic acid acted as a catalyst or whether it merely retained the ammonia and made it possible to heat the mixture to a higher temperature without the loss of much ammonium acetate by dissociation. By heating ammonium acetate in sealed tubes, alone, and again with acetic acid and in other experiments with ammonia, we have shown that either acetic acid or ammonia acts as a catalyst and hastens the reaction. The liberation of ammonia by the addition of a little sodium hydroxide to the ammonium acetate, however, retards the reaction, probably because the acetate ions from the sodium acetate formed repress the ionization of the acetic acid formed by the dissociation of the ammonium acetate. These

$$CH_3COONH_4 \rightleftarrows \underset{H^+ + CH_3CO_2^-}{CH_3COOH} + \underset{H^+ + NH_2^-}{NH_3} \rightleftarrows CH_3\overset{OH}{C}\underset{NH_2}{OH} \rightleftarrows CH_3CONH_2 + \underset{H^+ + OH^-}{H_2O}$$

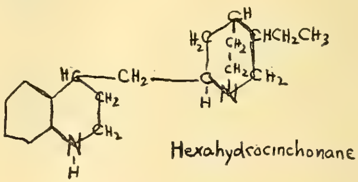
results point to the above mechanism for the reaction.

If this is accepted, it would seem that acetic acid catalyzes the reaction chiefly through its hydrogen ions and ammonia through its amide, NH_2^-, ion.

Preparation of absolute alcohol: W. A. NOYES. Beilstein contains a statement that alcohol is dehydrated commercially by means of calcium chloride but I have been able to find no other reference to the matter in the literature. A careful study has brought out the following: From strong alcohol containing somewhat more than one mol of calcium chloride for each mol of water present, alcohol of 99 per cent. or stronger may be distilled. On concentrating such a solution a solid alcoholate (not a hydrate) separates and there is an equilibrium between the alcoholate and hydrate present. A quite high temperature is required to expel the alcohol from this solid but if enough water is added so that about 5 mols are present for each mol of calcium chloride, the alcohol may be distilled away completely at a temperature below 140°. The hydrate of calcium chloride which remains is liquid at 100°, or above, but solidifies at ordinary temperatures. On the basis of the facts given, 99 per cent. alcohol may be prepared, by means of calcium chloride, without loss of alcohol. The remainder of the water can then be removed by lime or by some other method.

5, 8-diamino-dihydroquinine and 5, 8-diamino-6-methoxyquinoline, and their conversion into the corresponding amino-hydroxy and dihydroxy bases: WALTER A. JACOBS AND MICHAEL HEIDELBERGER. 5, 8-diamino-dihydroquinine, obtained by reducing 5-amino-8-*p*-sulfophenylazo-dihydroquinine (*J. Am. Chem. Soc.*, 1920, xlii, 2281); decomposes at 125–40°, and yields a vermilion, crystalline tetrahydrobromide and a brown crystalline sulfate decomposing at 220–7°. 5-hydroxy-8-phenylazo-dihydroquinine (*Ibid.*, p. 2280) yielded a crystalline double tin salt of 5-hydroxy-8-amino-dihydroquinine, the base and other salts being very unstable. Boiled with 1:1 hydrochloric acid the diamino compound yielded the dihydroxy dihydrochloride, vermilion needles decomposing at 208–11° (anhydrous), also obtained from acid solutions of the amino-hydroxy compound on long standing. For comparison the series derived from 6-methoxyquinoline was also prepared, 5, 8-diamino-6-methoxyquinoline forms golden leaflets melting at 163–4°; 5-hydroxy-8-amino-6-methoxyquinoline yellow crystals melting at 180–2°, and the 5, 8-dihydroxy compound yellow crystals melting at 195–7°. The lability of the amino groups in these compounds as well as in the previously reported dyes is thus shown to be of a high order.

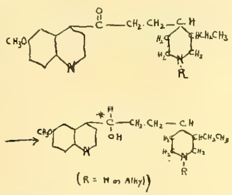
The hydrogenation of dihydrocinchonine, chinchonine, and dihydroquinine: WALTER A. JACOBS AND MICHAEL HEIDELBERGER. By reducing dihydrocinchonine with sodium in boiling amyl alcohol and converting into the hydrochlorides two stereoisomeric hexahydro bases were isolated, in which the 2ʸ alcoholic group had also been reduced. These α- and β-hexahydrocinchonanes (for terminology see *J. Am. Chem. Soc.*, 1920, xlii, 1492) were crystalline, and yielded characteristic hydrochlorides, nitroso, benzoyl, and phenlyazo derivatives, thus showing the properties of tetrahydroquinolines. From the mother liquors a small amount of hexahydrocinchonine dihydrobromide was isolated. The α- and β-compounds were also obtained by reducing dihydrocinchonane. Cinchonine yielded an α-tetrahydrocinchonane, convertible into the α-hexahydro compound with Pd and H, while the mother liquors also reduced with Pd and H gave the α-, β-, and hexahydrocinchonine-compounds. Dihydroquinine yielded chiefly hexahydroquinine dihydrochloride, characterized by the nitroso and benzoyl derivatives.



Hexahydrocinchonane

A new series of cinchona-like alkaloids: the dihydroquinicinols: MICHAEL HEIDELBERGER AND WALTER A. JACOBS. Reduction of the quinicines (quinotoxines) with palladium and hydrogen gives rise to a new series of alkaloids with an asymmetric secondary alcoholic group, thus resembling the cinchona alkaloids themselves. Quini-

cine hydrochloride gave *d*-dihydroquinicinol nitrate, which yielded the crystalline base and dihydrochloride. Only the *l*-dihydrochloride could be obtained. N-methylquinicine dihydrochloride gave both *d*- and *l*-N-methyl-dihydroquinicinol, which crystallized readily. The *d*-hydrobromide, dihydrochloride, and methiodide were prepared, as well as the *l*-dihydrochloride and methiodide. Similarly, N-ethylquinicine hydrochloride gave the *d*-base, from which the mono- and di-hydrochlorides and methiodide were prepared. An *l*-dihydrochloride was also isolated. Ethyldihydrocupreicine sulfate (optotoxin) gave the *d*-hydrochloride, from which the base and dihydrochloride were obtained. Methyl and ethyl iodide yielded the corresponding crystalline N-alkyl bases. *d*- and *l*-dihydrocinchonicinol sulfate were also obtained.



The action of ammonia on chlorobenzene and bromobenzene in the vapor state in presence of catalysts: A. Lowy and A. M. Howald. Ammonia mixed with the vapor of a halogenated benzene compound was passed over various catalysts at elevated temperatures to determine the possibility of replacing the halogen by the NH_2 group. Iron, nickel and cobalt were the only active catalysts. The optimum temperature for iron was 480° C. and gave a yield of 7.35 per cent. of aniline. The catalysts used were rapidly poisoned. This substantiates previous experimental evidence that halogens have poisonous effects upon catalysts. Several oxides, salts, elements and alloys were also tried as catalysts.

The effect of fullers' earth on pinene and other terpenes: C. S. Venable and E. C. Crocker. An investigation has been made of the effect, under various experimental conditions, of fullers' earth on pinene and other terpenes. In the presence of fullers' earth, various terpenes react spontaneously or upon a slight elevation of temperature. In the case of pinene, the first effect is that of intermolecular rearrangement, the chief products being dipentine and terpinene. These terpenes again react in the presence of fullers' earth to give dipinene, boiling point 320° C. It is conceivable that the intermolecular rearrangement and the polymerization take place simultaneously. The local overheating of the 320° fraction in the presence of fullers' earth results in a depolymerization with a formation of paraffin hydrocarbons, *p*-cymene, etc., and the 360° fraction. The course of reaction as thus shown is entirely different from that indicated by the work of Gurvich, *J. R. P. C. S.*, 1915–16. A similar set of reactions has been observed for dipentine, terpinene, camphene, beta pinene, active limonene, sabinene and terpineol. The reaction in the case of cineol is very slow; *p*-cymene does not give a reaction.

A study in yields in nitrating nitrotoluenes: J. M. Bell and D. M. Carroll.

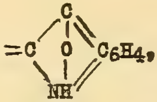
Studies on nucleic acids: The reduction of uracil and cytosine by means of colloidal platinum: Treat B. Johnson and Elmer B. Brown. The reduction of uracil leads to a quantitative production of hydrouracil, which can be hydrolyzed quantitatively to β-alanine. Transformations can be brought about at low temperatures in the pyrimidine series by catalytic reduction which can not be accomplished by other means.

Studies on nucleic acids: New color tests for the pyrimidine-thymine, applicable in the presence of uracil, cytosine and sugars: Treat B. Johnson and Oskar Baudisch. Thymine is oxidized in the presence of ferrous sulphate with formation of urea, pyruvic acid and acetol. Both pyruvic acid and acetol can be identified by characteristic color tests, which serve for the indirect identification of thymine. The reaction is of immediate service in determining the constitution of nucleic acids.

Hydantoin indigoids: Arthur J. Hill and Henry R. Henze. (By title.) Nuclear aromatic aldehydes condense readily with the methylene (CH_2) group of hydantoin and many of its derivatives. On the contrary, however, only three aliphatic aldehydes have been directly combined with hydantoin while there is no literature bearing on the behavior of the carbonyl group of ketones toward this type of compound. The writers have been able to effect condensation between certain hydantoins, namely, 1-phenyl-2-thiohydantoin, 1-phenylhydantoin and hydantoin, and the cyclic ketone isatin, and its chloride. Two types of condensation products have thus been obtained,

namely, β-isatin derivatives from isatin itself, and α-derivatives from the α-chloride.

These new products are all highly colored, and, in their molecular configuration, resemble the dyes of the indigoid group. The color of α-derivatives, which contain the true indigoid chromophore,

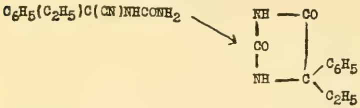


as postulated by Claasz, is deeper than that of the corresponding β-homologues.

Synthesis of the soporific nirvanol (4, 4-phenyl ethyl hydantoin): William T. Read. Nirvanol (4, 4-phenyl ethyl hydantoin), a soporific now extensively used in Europe, has been made in good yield by the following method. Phenyl ethyl ketone, prepared from propionyl chloride and benzene by the Friedel and Crafts reaction, is condensed with ammonium cyanide in alcohol solution.

$$C_6H_5COC_2H_5 + NH_4CN \rightarrow C_6H_5(C_2H_5)C(CN)NH_2.$$

The resulting α-phenyl α-aminobutyronitrile, or its hydrochloride, is treated with potassium cyanate in glacial acetic acid solution, whereby phenyl ethyl hydantoic nitrile is obtained. The nitrile is readily converted into 4, 4-phenyl ethyl hydantoin by boiling with hydrochloric acid.



The synthesis of β-chlorallylchloride from α, γ-dichlorhydrin: Arthur J. Hill and Edwin J. Fischer. A practical method for preparing chlorallylchloride is not described in the chemical literature. A method has now been developed for the practical preparation of this chloride from dichlorhydrin by dehydration of the latter with phosphorus oxychloride. This chloride is of immediate interest and value

$$ClCH_2.CHOH.CH_2Cl \rightarrow ClCH : CH.CH_2Cl$$

for the synthesis of new organic combinations of therapeutic and pharmacological interest.

The action of ferrous hydroxide-peroxide on thymine, lactic acid and alanine: Oskar Baudisch. Ferrous hydroxide-peroxide acts in a double capacity as an oxidizing and a reducing agent. From a biochemical standpoint it behaves like an enzyme. As a chemical reagent it has received hitherto very limited attention, but its marked activity at ordinary temperature due to the presence of iron in its molecule stimulates a special interest in a study of its action on biochemical products.

The behavior of cystine to acid hydrolysis: Walter F. Hoffman and Ross Aiken Gortner. Many authors agree that the amino acid, cystine, is destroyed by acid hydrolysis but no decomposition products have been isolated. In the present study a large quantity of cystine was boiled with 20 per cent. hydrochloric acid for 196 hours, aliquots being removed at intervals of 3, 6, 12, 24, 48, 96, 144, and 196 hrs. Various possible chemical changes were followed throughout this period. The authors find that (1) decarboxylization and deamination proceed very slowly, (2) that the sulfur is not markedly broken off by boiling, and (3) that the major change is the alteration of the cystine molecule into an "isomeric" cystine with different crystal form and different solubilities, which forms different derivatives from ordinary cystine. Approximately 90 per cent. of the original cystine was isolated as "isomeric" cystine after boiling for 196 hrs.

A comparison of certain derivatives of "protein" cystine and the "isomeric" cystine formed by acid hydrolysis: Ross Aiken Gortner and Walter F. Hoffman. Certain derivatives of the "isomeric" cystine noted in the preceding paper were compared with the corresponding derivatives of the natural l. cystine. Protein cystine crystallizes in large hexagonal plates, the isomeric cystine in tiny microscopic prisms. The benzoyl derivative of l. cystine crystallizes in needles, m. p. 180–181°. The "isomeric" benzoyl derivative crystallizes in diamond-shaped crystals, m. p. 168°. The phenyl isocyanates melt at 148–149° and (isomeric) 181°, respectively. It was found impossible to prepare a phenyl hydantoin from the phenyl isocyanate of the isomeric cystine, whereas a phenyl hydantoin melting at 122–123° was easily prepared from the corresponding derivative of the normal l. cystine. The cysteic acids were prepared and show different properties and different crystal form. The study is being continued.

Charles L. Parsons
Secretary

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CONTENTS

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WHAT IS THE MATTER WITH PHYSICS TEACHING?[1]

The recent appointment by the National Research Council and by the American Physical Society of committees on the teaching of physics shows that our physicists who are primarily interested in research are beginning to see that something is the matter with the college teaching of physics. The question in everyone's mind is "Why the widespread dislike of physics by college students?" As a long-time member of this society I have had much intercourse with engineering teachers, and I have long had in mind an additional question: "Why the widespread contempt of physics teaching among engineering faculties?"

Before giving my answer to those questions I must point out that there is one kind of contempt of physics teaching among engineering teachers which is to the discredit of engineering teachers themselves, namely, the contempt which many of them have for straight and accurate thinking which does not conform to their own careless ways. When I meet with this contempt, which is much too often, I am sorry to say, I always think of a phrase P. G. Tait used in a discussion he gave many years ago of the perennial question of elementary mechanics. "In defense of accuracy," says Tait, "we must be zealous, even unto slaying." It must be conceded that P. G. Tait's ideas concerning elementary mechanics were and are absolutely correct as far as they go, and, after agreeing to use the word weight to designate the pull of the earth on a body, he never reverted to the usage of the grocer and the coal man. This is a thing many of our en-

[1] The opening of a discussion of physics teaching at the Orono meeting of the New England Section of the Society for the Promotion of Engineering Education; autumn, 1921.

gineering teachers do, and it is a thing many of us physics teachers never will do.

Concerning physics teaching, my own opinion is that students dislike physics because they accomplish so little in the study of it in our elementary college courses; and I believe that they accomplish little because the simple, fundamental mathematical ideas and methods which constitute elementary physics are not sufficiently stressed in the class room and not set forth with clearness and brevity in our text-books.

"The instantaneous acceleration of a body is the limit of the ratio $\Delta v/\Delta t$ as Δt approaches zero, where Δv is the change of velocity in time Δt"; but the limit of $\Delta v/\Delta t$ is unthinkable unless one knows the manner in which Δv and Δt approach zero. Advanced students supply this deficiency, as they look backwards at such a definition, by thinking that they think of the so-called principle of continuity! But what is the principle of continuity to a beginner? And what is the beginner to do? The definition of instantaneous acceleration can not be given either logically or intelligibly except in terms of a specific algebraic example where the manner in which Δv and Δt approach zero is clearly evident. I mention this definition of instantaneous acceleration because it is given as stated in nearly every physics text known to me; and yet we ask why students dislike physics. Many physics teachers maintain that it is the business of our mathematics teachers to clear up all mathematical difficulties; but I believe, most decidedly, that the main business of the physics teacher is to cooperate with mathematics teachers in this extremely important matter. I am here considering mathematics largely as a method of thinking, and, surely, if all the difficulties in this method of thinking were cleared up by our mathematics teachers there would be but little left for us physics teachers to do.

Let us consider another example. A fluid at rest pushes normally on an exposed surface, or the exposed surface pushes normally against the fluid. Most of our physics textbooks attempt to explain this fact by stating that the shear modulus of a fluid is zero! Or by the following pseudo argument: "If the force exerted on the fluid by an element of the surface were inclined to the surface it would have a component parallel to the surface, and this tangential force would set the fluid in motion; therefore, etc., etc." Now it is absurd to say what this tangential force will do to the small adjacent portion of the fluid without considering the forces exerted on the portion by the surrounding fluid. Many such pseudo arguments may be found in almost any of our physics texts, and I believe they account in large part for the difficulties our mathematics teachers have in the teaching of mathematics. Our physics teachers not only do not help in the important matter of mathematical training but they sometimes hinder this highly important business.

But slovenliness in mathematics is not the only fault in our physics texts. Many a student comes from his boarding house to the class room to hear his physics teacher formalize about position and displacement, although not one of the formalities needs to be used, because the student's already existing knowledge of coming and going is fully sufficient for everything his physics teacher will give him. No wonder that a student never *goes* from the class-room to his study to read about position and displacement in his physics text, even if there should be the grain of a new idea mixed up with the intolerably stupid and immediately purposeless discussion.

A young man from the high school is expected to be edified by the study in college of a physics text which discusses levers of the first, second and third classes, which gives all the old stuff about "simple machines"; and which contains little else that is clear and concise and correct and purposeful!

In the technical school the student is scheduled to study such things as water wheels, and pumps, and engines, and yet he is expected to study a physics text in which all these things are set forth, but no more completely than in his high-school physics

text. This surely is a side-stepping procedure on the part of the physics teacher, because the student's burning need is to be trained in mathematical thinking, and it is absurd to waste time in any descriptive study unless it be with some immediate and attainable analytical end in view.

To illustrate faults of physics teaching by examples chosen from mechanics is comparatively easy; but to illustrate by examples chosen from the equally important subject of electricity and magnetism is very difficult. One reason for this difficulty is, of course, evident; but, in my opinion, the chief reason of the difficulty is that the usual presentation of the elements of electricity and magnetism is so bad as to be beyond the range of intelligible illustration, so bad as to be actually unthinkable! Here is an attempt at an example, and I might attempt a great many as unthinkable as this! Any wheelbarrow pusher may, if he chooses, think that when he stops a wheelbarrow he does not simply stop it, but he imparts to it an "extra velocity" in a backward direction. No one would quarrel with such a wheelbarrow pusher, much as one might be tempted to poke fun at him. But what of the text-book-writing physics teacher who injects into a many-page discussion of self-induction the essentially useless idea of "extra current," and in a way which, when reduced to wheelbarrow language, is exactly equivalent to thinking that he thinks that the "extra velocity" to be imparted to a stopping wheelbarrow is a forward velocity! And yet we ask why students dislike physics.

The above examples of unintelligible halfway mathematics, of fallacious argument, of purposeless formality, of tiresome repetition and of easy side-stepping have been chosen from the subject of mechanics, and the one attempt to illustrate the futilities which ordinarily pass as the *elements* of electricity and magnetism has led us back again to mechanics! Why? Because mechanics is the only branch of physics in which a real beginning has been made in the use of precise ideas by common men.

I know, from experience, that most of our students like physics when the teaching is directed insistently towards the development and use of precise ideas, and I know that the majority of our students can be carried a long way in this difficult but highly profitable business.

But the greatest difficulty in the teaching of physics is to persuade the student to study his text book, and in the face of this difficulty physics teaching has degenerated into interminable class-room coaching, making our teaching not only very exhausting but also frightfully expensive, and greatly weakening the morale of our students. What are we to do about it?

President Hadley made a statement in a brief address before the New Haven Convention of this Society in June, which alone would justify the Convention if it could be taken to heart by our teachers. He said that, although at one time, many years ago, books were used too much, at least, too slavishly, they are now used too little; and the most pressing present need in education work is to place more dependence on books. What are we to do about it?

No one would wish a student to use a book unless he can be led to use it effectively, and the trouble, in physics, at least, is that our text-books can not be used effectively. I am, of course, familiar with what is usually considered to be an effective use of a physics text in our non-exacting college courses in physics which run largely to appreciation-stuff, but I do not consider such use to be effective, most emphatically I do not.

I have discussed college physics teaching with a great many men, and when the discussion has turned to the question of the text book I have always been struck by the tendency of those whom I have known to be the best of teachers to point out the contrast between what they say and do in the classroom and what stands in the text-book. Most of our physics teachers seem to think that a text should be a compendium of all the manifold allusions, suggestions, plausibilities, comparisons, analogies, cross-refer-

ences and explanations which enliven the recitation and lecture and which serve as nothing else can serve to stimulate the student's imagination; but no student can work on such things, and the text-book must be something on which he can work.

The idea is somehow widely prevalent among students, and also among teachers, that the understanding rather than the memory should function in the study of physics; but no one can understand anything until many things are fixed in the mind. The student should be required to burn into his memory all definitions, all statements of principles and laws, all elementary proportions with their proofs and all important equations with their derivations. When he does this he will get a hundred times as much as he can otherwise get from his lectures and recitations, the sum total of his effort will be reduced, and his worry will cease to exist.

The most distressing idolatry the world has ever seen is the modern, popular, science-worship which pays no tithes and takes no pains. It is our Great Religion. Its catechism is science teaching which abhors exactions; its litany is the semi-serious wail of regret of our easier college graduates that a silver-spoon smartness was not transmuted by a pleasant college course into what they conceive the talents of its priesthood to be; and its beatitudes are the above-mentioned appreciation-stuff which imbues every easy-going dilettante with a false sense of understanding the universe and encourages every would-be parasite to think exaltingly that science is the building of steamships to carry him where he has no need to go, of railways to bring him things he could do better without and of airplanes to carry quickly his letters which could not lose in meaning if their time of transit were to take a thousand years!

Most people think of science in terms of its results, chiefly, indeed, in terms of results which facilitate joy riding of all kinds, including easy orgies of near-thinking; but science is Finding Out and Learning How, its great gift to those of us who live inside of its frontiers is an understanding of the things which surround us and of the things we have to do, and its price is pains.

SOME STATEMENTS CONCERNING THE TEACHING OF PHYSICS

Arranged to Promote Discussion at the Orono Meeting of the New England Section of the S. P. E. E.

The teacher must not mistake the fixity of an idea as its *raison d'être*. As relating to ideas fixity and reason are not the same thing, especially when it comes to transmitting ideas to students.

The teacher who mistakes fixity for reason does not, as a rule, exercise himself greatly in his teaching; and the teacher who does put energy into his teaching needs, above all things, to guard against what may be called the "illusion of activity" which is the feeling that one is doing a thing well when one is doing it with all one's might! When a teacher does a lesson with all his might, the students may be doing nothing at all.

It is not the teacher's business to promote the use of the metric system, partly because any effort he may make in this direction is pretty nearly sure to be wasted, and partly because he has too much else to do.

Let the teacher use familiar units wherever possible. In mechanics let him use English units and refer briefly to c.g.s. units. In electricity and magnetism let him use the units of the volt-ampere-ohm system wherever these units can be used, and let him use the electromagnetic c.g.s. units where it is necessary to use them.

Nothing in the teaching of physics is of greater importance than to frame numerical problems so that the data as given might be determined by actual laboratory test. The consistent following of this rule will do much to develop physical sense in the student; and neglect of this rule is sure to leave the student "up in the air."

Ask a student about the effect of an unbalanced force on a body and he is apt to make the

following sounds in answer: *eff equals emm aye!* Do not tolerate the mere reading of an equation in answer to a physical question.

Do not tolerate vague statements. It is physically meaningless to say, for example, that acceleration is gain of velocity divided by time." The proper statement is that the average acceleration *of a body during a given time* is equal to the velocity gained *by the body during the given time* divided by the time. It is meaningless to say that "density is mass divided by volume." The proper statement is that the density of a body is equal to the mass of the body divided by its volume.

Require the student to make every statement of definition, every statement of principle, every explanation of an equation, etc., as relating explicitly to a particular condition or thing.

The natural desire for brevity of statement is often allowed to go much farther than the elimination of the important element of explicitness as above pointed out, and lead to complete obscurity of meaning as illustrated by the following example: A string 10 feet long is tied to a post and a force of 5 "pounds" is exerted on the post by pulling the string. This force certainly "acts through a distance of 10 feet," and, the work done is 50 foot-"pounds" because "work is done when a force acts through a distance." This argument is found to be acceptable to about 60 per cent. of the men beginning a college course in mechanics! No! *Work is done when a body on which a force acts moves in the direction of the force,* and no dictionary ever defined the word *through* in a way to justify the use of the word to abbreviate this 18-word statement as it is usually abbreviated in the study of physics (?) in school and college. Language has been developed as a medium for dickering, quarreling and love-making, and language as used in precise physical specifications is always more or less awkward and more or less strained; but it is a serious mistake to obviate these things by using meaningless expressions and phrases.

I have never talked with an electrical engineer who retained any helpful knowledge or understanding whatever from the study of electrostatics in his college course in physics; and every electrical engineering teacher will tell you that he cannot count on any knowledge or understanding, even incipient knowledge and understanding, of electrostatics among students who have just finished their college course in physics.

WM. S. FRANKLIN
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

REQUIREMENTS OF A MONOGRAPH ON THE CHEMISTRY OF CELLULOSE[1]

IN a seminar devoted exclusively to the chemistry of cellulose certain topical assignments were made to the students, who, after a careful and critical survey of the literature, reported their findings. The course served to emphasize a number of sad facts that are undoubtedly known to all students in the field of cellulose chemistry. We were impressed by the enormous number of undigested, uncorrelated facts that had been amassed apparently as a result of technological studies. We were further impressed by the relatively small number of fundamental studies (bearing the earmarks of painstaking critique on the part of the investigator) that had a direct bearing on the constitution of cellulose, and by the amazing method of presenting these facts in our best English text. It became quite evident as our course proceeded, that there was a lack of vision in the interpretation of noteworthy results in the literature; that little attention had been paid to the methods employed or judgment exercised by investigators in the experimental portions of their work; that scant attention had been given to the correlation of isolated experimental data, and that little differentiation had been made between qualitative and quantitative data in the formulation of hypotheses. To present the case briefly—it became very apparent that a *critical* monograph in the English language was little less than a necessity. Since the close of our seminar, Heuser's new "Lehrbuch der Cellulose Chemie" has appeared, and this splendid work will receive further mention.

A few examples will serve to illustrate the various points previously raised. Take the

[1] Read at the meeting of the American Chemical Society, New York, September 9.

case of the scientific investigations stimulated by the mercerization reaction. Since 1850 (or thereabouts) a number of investigators including Gladstone,[2] Vieweg[3], Thiele,[4] Cross,[5] and others have assigned various formulas to the compound (or compounds) that had been formed between cellulose and sodium hydroxide when concentrated alkali acted upon cotton. The existence of such compounds was disputed by Hubner and Teltscher[6] and later by Leighton.[7] From a hasty review it would appear that the existence of a definite compound between cellulose and sodium hydroxide had never been demonstrated, and that alkali cellulose may perhaps be attributed to adsorption phenomena. Nevertheless, Leighton's work has not affected our interpretation of the constitution of viscose, which presupposes a cellulose alcoholate, ($C_6H_9O_4ONa$ or some similar compound) which then reacts further with CS_2 to form at the outset of the "ripening" process sodium-cellulose-xanthogenate, which gradually hydrolyzes with the loss of NaOH and CS_2 until cellulose is regenerated. It remains possible of course that the xanthogenate reactions given in our texts accurately represent the formation of viscose—and yet, in the light of Leighton's investigations it is disconcerting to note the quiet assurance and certainty with which this explanation of the xanthogenate reaction is generally accepted.

A far more striking example of the lack of critic and indifference with which experimental details are treated in our modern cellulose literature is to be found in the case of the hydrolysis of cellulose to glucose. Our literature has been replete with confident statements that within the limits of experimental error, cellulose is quantitatively hydrolyzed to d-glucose:

$$(C_6H_{10}O_5)_n + nH_2O \rightarrow nC_6H_{12}O_6.$$

Irvine and Soutar,[8] however, have justly shown that this claim has always been made on the grounds of questionable or incomplete experimental evidence, and that in no case was dextrose or a dextrose derivative isolated in any amount approaching the theoretical yield. There is no object in reviewing the work of Flechig,[9] Schwalbe and Schultz,[10] Willstätter and Zechmeister,[11] or Ost and his co-workers.[12] Such a review would either show indirect evidence or incomplete evidence regarding this very fundamental reaction. *It is only within the past year* that Irvine and Soutar themselves[8] have shown that the above equation is substantially correct and that at least 85 per cent. of dextrose is formed when cotton cellulose is hydrolyzed. They failed to account for less than 15 per cent. of the hydrolysis products. Irvine's work is noteworthy in that he isolates his compounds in a state of analytical purity. His experiments are all quantitative and all of his products are definitely identified. The judgment and critique exercised throughout this study are remarkable, and the research must stand as a classical one. It presents a marked contrast to the previous investigations in the same field. It is furthermore interesting to note that whenever the cellulose-dextrose relationship has been brought into question, the question has not been raised as the result of some investigators' lack of critique, but because of certain reactions (like the bromomethyl furfural reaction of Fenton and Gostling) which were themselves far from quantitative, and the mechanism of which was not fully understood.

During the course of the myriad cellulose investigations that have crowded our literature, a number of so-called "compounds" of cellulose have been isolated and characterized. Let us examine briefly the case of the "oxycelluloses," compounds obtained by the oxidation of cellulose. There is no necessity of reviewing the methods of formation, or the properties of these substances. If we accept Hibbert's view of the constitution of cellulose, the oxidation of cellu-

2 *J. Chem. Soc.*, *5*, 17 (1853).

3 *Ber.*, *40*, 3876 (1907).

4 *Chemiker-Ztg.*, *25*, 610 (1901).

5 "Cellulose," p. 23.

6 *J. Soc. Chem. Ind.*, 28, 641 (1909).

7 *J. Physical Chem.*, *20*, 32 (1916).

8 *J. Chem. Soc.*, 117, 1490 (1920).

9 *Z. physiolog. Chem.*, 7, 523 (1883).

10 *Ber.*, 43, 913 (1910).

11 *Ber.*, 46, 2401 (1913).

12 *Chem. Ztg.*, 34, 461 (1910).

lose might run the entire gamut of hydroxyaldehydes, hydroxyketones, hydroxyacids, ketoacids, etc., that could result from a product having two secondary and one primary alcohol groups for each six carbon atoms. Since the oxidation reaction is not infrequently accompanied by hydrolysis, the possible number of products is accordingly increased. We have here a limitless field for speculation, and can think of an indefinite number of oxycelluloses, depending upon the type of oxidizing agent, the conditions of oxidation, on the amount of oxidation product adsorbed on the residual cellulose, and possibly on other factors as well. It is quite evident that we can hardly hope for a homogeneous substance, and it is obvious that oxycellulose is a very vague and illusive term. It has no particular chemical significance and yet it persists in our present-day text-books on cellulose. The term "hydrocellulose" and "cellulose hydrates" enjoy a similar distinction. The former has been shown to be a mixture of hydrolytic degradation products of cellulose and cellulose itself. Whereas the latter (in many cases at least) appears to be cellulose itself—changed physically it is true—but hardly meriting the term applied to it.

I might continue further and point out the incongruities in our literature on lignocellulose and the other so-called "compound celluloses," or the ever-shifting meaning of the term cellulose itself when applied to a substance other than the seed hairs of the cotton plant. Further reference is unnecessary however. It is quite clear that we have certain chemically meaningless but highly respected terms in our cellulose literature, that the results of numberless experiments remain uncorrelated with the properties of the typical cellulose and that our cellulose literature is becoming increasingly unwieldy. I hasten to add, however, that in certain quarters this lack of critique and cohesion is rapidly being remedied—and it is in these quarters that our monographers should seek their inspiration.

To my mind, the primary objects of any monograph on cellulose are: (1) to stimulate further research along scientifically profitable channels; (2) to present the literature in such a way that the reader may have a reliable means of knowing whether or not previous statements can be accepted without reservation; (3) to present the data with a view towards giving the reader a comprehensive survey of the cellulose field without losing him in a maze of detail; (4) to pave the way for a more satisfactory definition of the term cellulose.

To gain these objectives, the author should remain uninfluenced (whenever necessary) by the orthodox procedure of previous writers, and should approach his problem in an essentially modern spirit. He must effect a liaison between some of the hitherto isolated facts in cellulose chemistry. He should use the greatest critical ability at his command, and give weight to results of those investigators who have used proper critique in their own work. Furthermore, he should select his material in such a way that with slight revision and proper additions, the work would remain a standard book of reference for a number of years to come.

It is quite possible to cleverly compile into a scholarly treatise (or series of treatises) a mass of detailed information—but such a volume would hardly meet our requirements. We need a critical compilation—suggestively written—that will give due weight to important qualitative reactions of cellulose and to the results of quantitative studies as well. The danger of formulating hypotheses on the basis of purely qualitative reactions should be constantly kept in mind. Articles in which unwarranted conclusions have been drawn without sufficient data, or in which the critic of the investigator is questionable should be subordinated or entirely deleted. Many of the vague terms now in common usage in the cellulose literature should be redefined or excluded.

Technological aspects of cellulose chemistry deserve no place in such a monograph. Paradoxical as it may seem, such a volume should in the end prove more serviceable and suggestive to the cellulose industry than would one which is diluted with references to the technological processes. This is especially true since we are already in possession of some noteworthy monographs in which these

technological processes have been compiled with the greatest patience and industry.

At the outset it would be advisable to publish only one monograph dealing with cellulose chemistry. It would be unfortunate if the society published a series of separate monographs on such subjects as (let us say) cellulose hydrates or oxycellulose. If one monograph cannot be made the joint work of two authors (an organic and a physical chemist), it might be well to have two monographs, one on the "chemistry of cellulose," and one on "cellulose as a colloid." Needless to say these books should supplement each other. I can not help feeling that an extended series must lead us into the same difficulties that we have encountered in the past, and I do not think that such a series would prove a good investment. Certainly the details in a number of volumes of an extended series would be obsolete in a comparatively short time. A carefully written volume of 300–400 pages with a properly classified bibliography should serve our purpose better than would an entire series.

I claim no originality for the ideas set forth nor are they Utopian. They form the basis of Heuser's recent "Lehrbuch der Cellulose Chemie." From the standpoint of the organic chemist, Heuser's Lehrbuch is the best monograph in its field. Unfortunately it was published several months too early to include the results of Hibbert's and Irvine's work on cellulose and Haworth's work on cellobiose, and it suffers accordingly. Heuser has written with a clear vision of the requirements of a modern monograph on cellulose. His writing is singularly free from circumlocution and from perplexing detail. He develops his subject matter clearly and logically. He has, however, omitted full reference to the modern work on the colloidal chemistry of cellulose, an oversight that should be corrected in any American monograph.

Summary.—(1) We require a monograph on the chemistry of cellulose that briefly and critically presents the most noteworthy results in the cellulose field. (2) The monograph must be more than a painstaking compilation. (3) It should carefully select the literature dealing with the most important reactions of cellulose as well as the results of the more recent researches on the physical properties of cellulose. (4) It should be written to stimulate fundamental research. (5) It should be free from inconsequential or meaningless terms and hypotheses.

Louis E. Wise

N. Y. State College of Forestry,
Syracuse, N. Y.

EUGENICS—THE AMERICAN AND NORWEGIAN PROGRAMS

Dr. Jon Alfred Mjøen, recognized by the Norwegian Government as the leader in eugenic and hygienic reform, issued from the Winderen Laboratorium, May, 1908, the following "Program for Race Hygiene":

Negative Race Hygiene. (*a*) *Segregation* (negative colonization system) for feeble minded, epileptics and similar physically and mentally crippled individuals, obligatory for drunkards, habitual criminals, professional beggars and all who refuse to work. (*b*) *Sterilization.* No compulsory sterilization in general. *Certain types* of criminals who wish to escape segregation should be given an opportunity to be sterilized.

Positive Race Hygiene. (*c*) *Biological Enlightenment.* Education of women in school and university should be changed from the present masculine system to one adapted to the female intellect and mind. Biology (renewal of the family), chemistry (nourishment of the family), and hygiene (protection of the family) should be chief subjects (obligatory), from the preliminary class in the boarding school to the university.—Race biology in school and university institute for genealogical research. State laboratory for race hygiene. (*d*) *Tax-*, *Wage-* and *Colonization*-system in favor of families, maternity insurance and other protective measures of prenatal kind. Positive colonization system. Regressive tax and progressive wage system for heads of families.

Prophylactic Race Hygiene. (*e*) *Combating racial poisons:* industrial poisons, especially lead and lead compounds; pathological poisons, especially syphilis; narcotic poisons, especially alcohol. (1) Prophylaxis of race illnesses and race anomalies as a state function. (2) Health declaration before marriage. (3) Class-system and progressive taxation for alcoholic liquors. (*f*) Crossings between

distant races should—until we have collected more knowledge—be avoided.

Doctor Mjøen has requested the writer to add his comments and to epitomize the situation in America. The writer has sent the following reply:

In general I approve of the Program for Race Hygiene issued from the Winderen Laboratorium in May, 1908, under Dr. Jon Alfred Mjøen, but I would like to add that there are special aspects of the problem as presented in America.

(*a*) *Education.*—The aspect of the race hygiene or eugenics movement which interests us most with respect to the United States of America is *popular education.* Legislation, both positive and negative, in this country will be of little avail unless supported by widespread popular knowledge and popular sentiment. When we witness the amazing progress that has been made in this country during the last twenty-five years regarding personal hygiene and especially the manner in which the discoveries of Pasteur, of Koch, of Lister, of Dakin, Carrel and others have become matters of common knowledge and practise among the people, we should not despair of creating similar widespread reform in family life through popular education. In fact an excellent beginning has been made in our schools and colleges towards both positive and negative race hygiene. Matters which were not considered proper even to mention twenty years ago are now simply and naturally spoken of as being of very great importance to the future of the race.

(*b*) *State Legislation.*—Many of the American state governments have become suddenly aroused to the fact that money which should be devoted to education, to public utilities, to sound and healthy amusement of our population, is diverted to the humanitarian care of members of society who are of no service to the state and who, unless cared for and segregated, are actually a menace to the state as well as a very serious economic loss.

(*c*) *Immigration.*—The American political principle that all men are created free and equal, while designed to indicate that all men should have equal rights before the law, has been interpreted to mean racial equality in intellectual, spiritual, moral, and physical endowment; investigations made during the World War struck a very hard blow to such American optimism. We discovered, for example, that our people, on the average, had lost two and a half inches in stature since the Civil War; that races like the English, the Irish, and the Scotch, coming from a similar geographic region, show marked inequality in intelligence. At the very bottom of the list stand certain races from central Europe which have been coming to America in enormous numbers. It is facts of this kind, brought by anthropologists to the attention of the American Congress, which have led to a very careful survey and restriction of immigration.

(*d*) *The Outlook.*—While we are aware that we are rapidly losing some of the best elements of our old American stock, which is being replaced in some regions by very inferior stock, we do not regard the outlook as discouraging, provided we act immediately, without prejudice, and openly, and make our strongest appeal to national sentiment. America has shown over and over again that she can make any sacrifice, and make it very quickly, if she is assured that the sacrifice is necessary for the preservation of her institutions on which the common safety and welfare depend. Consequently this is no time for discouragement, but the time for a very strong appeal to the patriotism of our people.

At a meeting of the members of the International Commission, namely, Leonard Darwin (President of the first Congress), Lucien March (representative of the French Government), Raymond Pearl (of Johns Hopkins University), Charles B. Davenport (of the Carnegie Institution of Washington, Cold Spring Harbor, New York), in consultation with ten leading representatives from other countries and from the United States, an *ad interim* committee was appointed to continue the work of the Congress until a permanent American committee could be selected by the main International Commission, which has its seat in London. In this connection the following letter was addressed by the writer to Professor Irving Fisher of Yale University:

October the eleventh,
Nineteen hundred twenty-one

You will recall that the Congress authorized the appointment of an *ad interim* committee to carry on the work in America prior to the appointment by the International Commission. I have consulted with Major Leonard Darwin and Dr. Jon Alfred Mjøen on this subject and they agree with me that the wisest choice we could make of a Chairman is Professor Irving Fisher of Yale University. The *ad interim* committee will then be composed as follows:

Irving Fisher, Chairman, of Yale University,
Charles B. Davenport, Vice-Chairman, of the Carnegie Institution of Washington, Cold Spring Harbor, N. Y.,
Harry Olson, Judge of the Municipal Courts of Chicago, Illinois,
Madison Grant, Chairman of the New York Zoological Society,
C. C. Little, Secretary, of New York, Secretary of the Second Eugenics Congress.

We shall thus have different sections of the country well represented; we shall profit by the legislative experience of Mr. Grant and Judge Olson and the expert scientific knowledge of Drs. Davenport and Little. As soon as the Eugenics Exhibit closes at the American Museum, the offices may be transferred to the American Eugenics Record Office at Cold Spring Harbor.

The present executive committee will disband as soon as the costs of the Congress are adjusted and the publication of the volume of papers and proceedings is arranged for.

I have appointed the following Committee on Publication of the *Proceedings* of the Second International Congress:

Charles B. Davenport, Chairman,
Clark Wissler, American Museum of Natural History,
H. H. Laughlin, American Eugenics Record Office, Cold Spring Harbor, N. Y.,
Henry Fairfield Osborn, *ex-officio.*

It is estimated that the publication will cost between $5,000 and $10,000, and I am writing to each of the great Foundations, namely, Carnegie, Rockefeller, and Commonwealth, asking for assistance, as the executive committee still has to raise a considerable sum to cover the expenses of the Congress.

According to the above terms it is proposed to actively disseminate the very valuable information contained in the seventy scientific papers and addresses presented to the congress by leading experts, also to provide for the continuation of the eugenics propaganda throughout the country. The writer retires from further active participation in this work in order to resume other duties. All inquiries should be addressed either to the Chairman, Vice-Chairman, or Secretary of the *ad interim* committee.

Henry Fairfield Osborn,
President, Second International Congress of Eugenics

New York,
October, 1921

SAMUEL STOCKTON VOORHEES

On the evening of September 23, at Portland, Maine, died Samuel Stockton Voorhees, Engineer Chemist of the Bureau of Standards, in the fifty-fifth year of his age. To a host of friends his passing brings personal sorrow because of loss of one endeared to them by his genial and manly qualities and deep regret that the chemical profession should be prematurely deprived of the services of a man so well informed and broadminded, whose conduct was always guided by high ideals.

Voorhees was born at Springfield, Ohio, January 15, 1867, his parents, of old American stock, being John Hunn and Elizabeth Aston (Warder) Voorhees. He studied at Lehigh University, in the class of 1888 without graduating and then took a special course in chemistry at Columbian (now George Washington) University, in Washington, D. C. He married in 1895 Laura Toucey Kase, of Danville, Pa., who with three daughters survive.

His first professional services were with the Cambria Iron Company, at Johnstown, Pa., and the Pennsylvania Railroad, at Altoona, Pa. In the employ of the latter he had the good fortune to be associated with the lamented Dr. Charles B. Dudley, a past president of the American Chemical Society, whom he always held in grateful remembrance. He there also formed lasting acquaintance with men who have risen to prominence in the railroad world. It was with two of them and other friends that he undertook the vacation trip to the north woods of Maine, where an illness from which he had long suffered developed to such an extent that he had to be removed under great difficulties to a hospital in Portland, where within a week he underwent two operations, from the second of which he was unable to rally.

Voorhees's railroad experience was continued during 1896 to 1899 with the Southern Railway Company at Washington, D. C., and Alexandria, Va., and from 1899 to 1901 with the New York Central and Hudson River Railroad, at Albany, N. Y.

The fifteen years of practical knowledge acquired in industrial fields fitted him admi-

rably for the government service into which he now entered and in which he remained during the rest of his life. From 1901 to 1908 he was engineer of tests in the office of the supervising architect of the Treasury Department and continued that work until 1910 after it was taken over by the Technologic Branch of the Geological Survey. In 1910 this service was transferred to the Bureau of Standards, where it has since remained.

Voorhees was at the time of his death a member of the American Chemical Society, the American Association for the Advancement of Science, the Washington Academy of Sciences, the Biological Society of Washington, the American Society for Testing Materials, and the International Association for Testing Materials. He was long a member also of the Society of Chemical Industry. In the American Society for Testing Materials he was most active, serving a term as vice-president and frequently on committees, participating in the preparation of many reports. It is upon these reports and the very many that he rendered in government service that Voorhees's professional reputation chiefly rests. His long and varied experience in the fields of railroad and structural supplies gave him a practical knowledge and a grasp of the applications of those materials such as few men possess.

Associated as I was with him for over eleven years at the Bureau of Standards, where he was in charge of a section of the chemistry division, I bear glad testimony to his intense loyalty to our government and to his unflagging zeal and industry on its behalf. To aid the government, the public and the industries was his constant aim. I also wish to acknowledge my own indebtedness for the strong support and wise counsel that were ever at my service. His loss left a void in the Bureau of Standards that will be hard to fill.

The social side of Voorhees was strongly developed. He was an active member of the Cosmos Club of Washington, enjoyed the company of others and contributed to their enjoyment, whether as genial entertainer or attentive listener, always the courtly gentleman. His disposition was most kindly, and any friend or neighbor in trouble or sickness was sure of his solicitous attention. Voorhees was an ardent fisherman, and it was with evident anticipations of a good time with the finny tribe that he set out on his trip to the Maine woods. His last note to me from camp, however, raised forebodings as he told of his inability to join in the sport he so enjoyed. Peace to the spirit of a fine man and a faithful friend.

W. F. HILLEBRAND

SCIENTIFIC EVENTS

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS' ASSOCIATION OF THE UNITED STATES

REPRESENTATIVE manufacturers of synthetic organic chemicals met at Washington on October 28 and 29 to effect a comprehensive national organization of the several closely related lines of manufacture included in this branch of chemical industry.

The name of the new organization is Synthetic Organic Chemical Manufacturers' Association of the United States. Its purposes, as set forth in the Constitution adopted, are

> To advance the science of organic chemistry by encouraging the manufacture in the United States of all kinds of organic chemicals; to cooperate with the various agencies of the Government of the United States in its efforts to develop, improve and render serviceable a complete organic chemical industry; to promote cordial relations between American concerns and individuals engaged in the production and use of organic chemicals; to afford means for the dissemination of scientific knowledge; to promote the highest scientific and business standards in relation to the industry; and generally to take such collective action as may be proper for the establishment and perpetuation of the organic chemical independence of the United States of America.

The association is subdivided into four sections—Dyestuffs, Pharmaceuticals, Intermediates and Fine Organic Chemicals—each section having a vice-president, a secretary and an executive committee. The administration of the association is in the hands of a board of governors, consisting of the president, the four vice-presidents, and ten members nominated by the sections.

The following officers were elected:

President: Chas. H. Herty, formerly editor of the *Journal of Industrial and Engineering Chemistry.*

Vice-Presidents: C. N. Turner of the Dyestuff Section; Herman Seydell of the Pharmaceutical Section; S. W. Wilder of the Intermediate Section; B. T. Bush of the Fine Organic Chemical Section.

Members of the Board of Governors: R. S. Burdick; R. C. Jeffcott; August Merz; M. R. Poucher; P. Schleussner and F. P. Summers.

The remaining four members of the Board of Governors, one from each section, will be elected later. The president and the four vice-presidents are ex-officio members of the board of governors.

THE EDITORSHIP OF THE "JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY"

Mr. Harrison E. Howe has been elected to succeed Dr. Charles H. Herty as editor of the *Journal of Industrial and Engineering Chemistry* and director of the A. C. S. News Service, which are conducted by the American Chemical Society. Dr. Charles L. Parsons, of Washington, secretary of the society, states that Mr. Howe has accepted the positions.

Mr. Howe was graduated from Earlham College and the University of Rochester. As chief chemist of the Sanilac Sugar Refining Company, in like capacity with the Bausch and Lomb Optical Company of Rochester, New York, and as manager of the commercial department of A. D. Little, Incorporated, of Boston, and manager of the Montreal offices of that organization, he became familiar with the broadest phases of industrial chemistry. In the war he was consulting chemist of the nitrate division of the Ordnance Bureau of the United States Army. Until his election to his present position Mr. Howe was at the head of the division of research extension of the National Research Council. He writes extensively for magazines on applied chemistry and is the author of a recently published popular work, "The New Stone Age."

Dr. Herty resigned the editorship to which Mr. Howe succeeds to accept the presidency of the newly formed Synthetic Organic Chemical Manufacturers' Association of the United States, which has opened offices on the 34th floor of the Metropolitan Tower at No. 1 Madison Avenue. Dr. Herty's career in chemical journalism has been varied by many public activities. By special appointment of President Wilson he went to Paris in 1919 as the representative of the United States in the matter of the distribution of German dyestuffs under the economic clauses of the Peace Treaty. Dr. Herty was also chairman of the committee of the American Chemical Society advisory to the Chemical Warfare Service, member of the dye advisory committee of the Department of State, and chairman of the advisory committee of the National Exposition of Chemical Industries. Before beginning this work, Dr. Herty had been a professor in chemistry at the University of Georgia and at the University of North Carolina. In his new position he will devote himself to the development of American synthetic organic chemical industry.

DIRECTOR OF THE HARVARD COLLEGE OBSERVATORY

As was noted last week in Science, Dr. Harlow Shapley, formerly of the Mt. Wilson Solar Observatory at Pasadena, Cal., and for the past eight months observer at the Harvard College Observatory, has been appointed director of the Harvard Observatory. That post has been vacant since the death of Professor Edward C. Pickering in 1919.

An article in the *Harvard Alumni Bulletin* states that Dr. Shapley was born thirty-five years ago at Nashville, Miss. He studied at the University of Missouri, and received the degree of Ph.D. at Princeton. From 1914 until last spring, when he came to Harvard, he was attached to the Mt. Wilson Observatory.

At Mt. Wilson he perfected methods of measuring star distances photometrically, and applied these methods to the problem of the distances and structures of the great star-clusters. His work has given a new perception of the size of the stellar universe, and

shown that it is at least a thousand times larger than it was thought to be before the distances to the clusters were measured. Dr. Shapley has discovered, furthermore, that the sun is not at the center of the sidereal universe, as was formerly supposed, but several hundred quadrillion miles away from it.

Dr. Shapley's studies of the famous star-cluster in Hercules known as "Messier 13" have proved that this cluster has a diameter of more than two and a half quadrillion miles, and contains probably more than 50,000 stars, each of them intrinsically brighter than the sun. His researches have also played a large part in establishing the fact that the great star-clusters are found only at immense distances from the plane of the galaxy, or Milky Way, but appear to be falling into it. Dr. Shapley's hypothesis is that the Milky Way itself may be composed of former star-clusters which have dissolved.

Dr. Shapley is also known as an entomologist, and has done interesting work in investigating the ants of the California mountains. He discovered that the speed at which these creatures move depends on the temperature, and that for some species the time of running through a "speed-trap," as shown by the stop-watch, gives the temperature of the surrounding air within one degree. He found that the ants went twelve times as fast at 100 degrees as at 50 degrees.

Professor Solon I. Bailey, who has been associated with the Harvard Observatory for more than thirty years and has been Acting Director since the death of Professor Pickering, expects to leave Cambridge within a few months for Arequipa, Peru, to take charge of Harvard's South American astronomical station there and place it again on a productive basis after a period of dormancy due to war conditions. He will resume his observations on the variable stars in southern clusters.

A SOUTHERN FOREST EXPERIMENT STATION

During July a new forest experiment station was established by the Forest Service of the U. S. Department of Agriculture, with headquarters, for the present, at New Orleans, La. Experiments will be conducted in the large and important timber region extending from eastern Texas, through Louisiana, Arkansas, Mississippi, Alabama, Georgia, Florida, to the Carolinas. Mr. R. D. Forbes, until recently superintendent of forestry for the Conservation Commission of Louisiana, has accepted the directorship of the station. Mr. Lenthall Wyman, formerly a member of the Forest Service in Arizona and Montana, and more recently in the State Forester's office in Texas, will be one member of the staff. Mr. W. R. B. Hine, a recent graduate of the Cornell School of Forestry, is the second member. One vacancy in the technical staff remains to be filled.

The importance of this region, in which large areas of land are suitable only for growing timber, makes the establishment of this station, to work out the best methods of producing, growing, and protecting the forests, particularly opportune. Such important and valuable species as longleaf, shortleaf and loblolly pines, and cypress amply justify a considerable outlay to insure their perpetuation and increase their production.

The establishment of the Southern Forest Experiment Station was made possible by a small increase in the appropriation for the investigative work of the Forest Service for the present year. It is not sufficient to permit the construction of buildings and laboratory facilities, and it is planned for the first year to concentrate on field work in the most urgent problems.

ORGANIZATION FOR RESEARCH AT THE PENNSYLVANIA STATE COLLEGE

The members of the American Association for the Advancement of Science at the Pennsylvania State College, State College, Pa., held a meeting on November 2. Dinner was served at the University Club to about thirty members. The speaker was Dr. L. R. Jones, professor of plant pathology of the University of Wisconsin and chairman of the Division of Biology and Agriculture of the National Research Council. His theme at this

meeting was "Organization for Research," in which he developed the idea of scientific research as a public service, not only in time of war but in time of peace as well, using the University of Wisconsin as an example of a state university functioning as a great public service institution through research work for the public good. He further showed how the modern state university is distinguished from the academy, the earlier type of educational institution, from the college, the modern institution which has replaced the academy in the matter of instruction, and from the modern endowed university, by the enlarged program of research for the public good which distinguishes the state university. Dr. Jones suggested as a means of fulfilling this public trust at state institutions the organization of "research committees" and "faculty subject groups" which are formed without regard to collegiate divisions. These are definite means of promulgating throughout the institution the relative importance of research as compared with other lines of activity and of emphasizing research as a much needed form of public service.

At the meeting it was voted by the members to petition the national council for a charter to form a local branch to be known as the Pennsylvania State College Branch of the American Association for the Advancement of Science. The purpose of the organization is to promote and stimulate research in the institution.

SIGMA XI LECTURES AT YALE UNIVERSITY

At a meeting on November 8 of the Yale Chapter of the Society of Sigma Xi, which was addressed by President James R. Angell of the University, announcement was made of a series of lectures to be given under the auspices of the Yale Chapter on the general topic of "The evolution of man." The lecturers and their subjects are considered of such general interest that it has been decided to hold the series this year in Lampson Lyceum, and to invite the public to attend the lectures without charge.

The first lecture of the series will be given on the evening of December 2, on "The antiquity of man," by Professor Richard S. Lull of the university faculty. The following are the subjects of the succeeding four lectures, which will continue through the month of March:

The natural history of man—Professor H. B. Ferris.

The evolution of the nervous system of man—Professor G. H. Parker.

Societal evolution—Professor A. G. Keller.

The direction of evolution—Professor Edwin G. Conklin.

It is expected that the 1921–22 lectures under the auspices of the Society of Sigma Xi will, as in the past, be published by the Yale University Press.

SCIENTIFIC NOTES AND NEWS

As a memorial to the late Edward C. Pickering, for forty-two years director of the Harvard College Observatory, it is proposed to erect near Cambridge an astronomical observatory, whose work will be largely concerned with the study of variable stars.

Dr. Harvey Cushing, of Harvard University and the Peter Bent Brigham Hospital, was elected president of the American College of Surgeons at its recent meeting in Philadelphia.

The Franklin Institute of Pennsylvania has awarded its Howard N. Potts gold medal to Dr. E. V. McCollum, professor of chemical hygiene in the School of Hygiene and Public Health of the Johns Hopkins University. The medal is awarded "for distinguished work in science or the mechanic arts," and was presented by the institute in recognition of a lecture on "Nutrition and physical efficiency," delivered before its members in 1920.

Sir J. J. Thomson succeeds Sir Richard Glazebrook as president of the Institute of Physics, London.

The Royal Society of Edinburgh has elected as president Professor F. O. Bower. The vice-presidents are Sir G. A. Berry, Professor W. Peddie, Sir J. A. Ewing, Professor J. W.

Gregory, Major-General W. B. Bannerman and Dr. W. A. Tait.

WE learn from *Nature* that Professor Léon Fredericq is to be presented with a medallion in recognition of his distinguished services as professor of physiology for fifty years in the University of Liège. The presentation will take place this month, when his son will take the chair which Professor Léon Fredericq has held so long.

THE quinquennial prize for the best work in medical sciences, offered by the Brussels Academy of Medicine, has been awarded to Dr. A. Brachet, professor of anatomy and embryology of the University of Brussels, for his contributions to topographical anatomy.

THE Italian Society of Internal Medicine at its eighteenth congress in Naples on October 26, celebrated the ninetieth year of Professor Cardarelli, and the fortieth year of Professor Maragliano's work as teacher. These physicians are the directors of *La Riforma Medica,* one of the chief medical journals published in Italy.

PROFESSOR P. GUTHNICK has been appointed director of the Babelsberg Observatory in succession to the late Herman Struve.

ERNEST P. BICKNELL, who has been representing the Red Cross abroad, has been appointed American National Red Cross Commissioner for Europe.

DR. H. C. DICKINSON, chief of the automotive investigations division of the Bureau of Standards, has been granted a leave of absence to become director of research for the Society of Automotive Engineers. He will continue to assist in the work of the bureau in a consulting capacity.

SECRETARY OF LABOR DAVIS has appointed a special committee to consider the welfare of immigrants coming through the principal ports of entry of the United States. The members are: Fred C. Croxton, chairman of the Ohio Council of Social Agencies; Miss Julia Lathrop, former head of the U. S. Children's Bureau; Miss Lola D. Lasker, of New York.

DR. WILFRED H. OSGOOD has been appointed curator of the department of zoology in the Field Museum of Natural History.

A GEOLOGICAL party of four, consisting of Professors R. A. Daly and Charles Palache of Harvard University, Professor G. A. F. Molengraaf of the University of Delft, Holland, and Dr. F. E. Wright of the Geophysical Laboratory, Carnegie Institution of Washington, will spend the coming winter in southern Africa. in a geologic and petrologic study of the Bushfeld igneous complex in Transvaal.

THE council of the California Academy of Sciences announces the appointment of Dr. Barton Warren Evermann as director of the new Steinhart Aquarium. The duties of this position will be in addition to those of director of the Museum of the California Academy of Sciences, which Dr. Evermann has held for many years. It was through Dr. Evermann's interest in fishes and aquariums that the late Mr. Ignatz Steinhart was induced to give to the California Academy of Sciences $250,000 for the construction and equipment of a public aquarium building in San Francisco. The council has selected Mr. Alvin Seale to be superintendent of the aquarium. For several years Mr. Seale was director of fisheries of the Philippine Islands. He also planned the Manila Aquarium, of which he was director during his several years' residence in the Philippines. He will be on duty throughout the period of construction and thereafter. The aquarium will be situated in Golden Gate Park, San Francisco, immediately adjoining the present museum of the academy.

THE new hospital of the Manchester and District Radium Institute was opened on October 7, by Lord Derby. It is the first hospital in England to be used exclusively for radium treatment.

BERT HOLMES HITE, chief chemist of the Virginia Experiment Station since 1895, professor of agricultural chemistry in the University of West Virginia since 1898, has died at the age of fifty-five years.

Miss Eunice Rockwood Oberly, librarian of the Bureau of Plant Industry of the Department of Agriculture since 1908, whose knowledge of the organization and relations of phytopathological literature was probably unique, died suddenly at her home in Washington on the morning of November 5.

John Augustine Zahm died in Munich, Bavaria, of pneumonia, on November 11. Dr. Zahm was born in Ohio and graduated in 1871 from Notre Dame, with which university he was connected for many years as head of its scientific department, as curator of its museum, and then as president of the board of trustees. He was the author of numerous books concerned largely with the relations of science to religion.

Dr. Emil A. Budde, the German electrical engineer, died recently at the age of eighty. He was president of the International Electrochemical Commission, succeeding Dr. Elihu Thomson.

The president and council of the Royal Society, London, announce that, in view of the economic condition of the country, the anniversary dinner of the society will not be held this year.

UNIVERSITY AND EDUCATIONAL NEWS

Sir Edward Allen Brotherton, Bt., M.P., has given £20,000 to the University of Leeds for the development of bacterial study and research, more particularly in the interests of public health.

A verdict of $25,000 damages has been rendered against Cornell University in the action brought by Louise Hamburger '20. In making his charge to the jury, Justice Kellogg said that the verdict to be given rested upon one point only, as to whether the university was negligent in employing a small boy in the chemistry stock-room. A motion for retrial has been made.

R. S. Lowe, of the Nitrate Division of the Ordnance Department of the Army, has been appointed dean of the department of chemical engineering of the University of Cincinnati.

C. R. Alden, formerly dean of the school of engineering, Institute of Technology, Detroit, has accepted an appointment as dean of the college of engineering, Ohio Northern University, Ada, Ohio.

Among changes in the medical faculty at Yale are: Dr. Francis G. Blake appointed John Slate Ely professor of medicine; Dr. Edwards Albert Park, professor of pediatrics; Dr. Arthur M. Morse, professor and head of the department of obstetrics and gynecology; Dr. John T. Peters, Jr., associate professor of medicine and Dr. Albert T. Shoal, associate professor of pediatrics. Dr. Samuel C. Hardey, associate professor of surgery, has been placed in charge of the surgical department of the school.

Dr. Lansing S. Wells, until recently a research chemist with the Barrett Company, Frankford, Philadelphia, Pa., has accepted an appointment as assistant professor of organic and physical chemistry, Montana State College, Bozeman.

Professor H. C. Plummer, F.R.S., has been appointed professor of mathematics of the Ordnance College, Woolwich, England.

At the opening of the winter session of St. Andrews University, Scotland, the newly appointed professor of chemistry, Dr. Robert Robinson, F.R.S., and the newly appointed professor of bacteriology, Dr. William J. Tullock, were inducted into their respective offices.

DISCUSSION AND CORRESPONDENCE

LATITUDE AND VERTEBRÆ

To the Editor of Science: In Science for December 26, 1919, is a suggestive note by Mr. A. G. Huntsman on the problem of "Latitude and Vertebræ" among fishes, a problem of reality and importance which I have thus had mostly to myself, and to which I have failed to find a solution. As Mr. Huntsman observes, not only have the northern species a progressively increased number of vertebræ, but a similar variation may occur within the limits of the species itself. In the flounder, *Hippoglossoides platessoides*, the northern examples have most vertebræ, while in the herring—*Clupea harengus*, the numbers of vertebræ decrease in passing from the

open sea, dense, saline and cold, to the Baltic. For this reason Mr. Huntsman suggests that the density of the surface water in which the eggs develop may be a decisive element.

In this connection, I may add a few additional data. In the group of Rock Cod or Rose-fish (*Sebastinæ*), the northern genera (*Sebastes, Sebastolobus*) have twenty-nine to thirty-one vertebræ, the tropical forms nearest related twenty-four, and the intermediate group of many species on both sides of the Pacific (*Sebastodes* and its allies) were supposed to have twenty-seven.

In verifying this statement I find that four of the more primitive of these forms (*Sebastodes paucispinis, S. goodei, Rosicola pinniger* and *R. miniatus*, have but twenty-five vertebræ, while all the others examined have twenty-seven as supposed, and the metameres in the very young are also twenty-seven.

Hitherto the extinct species of this tribe have remained unknown. I have, however, lately discovered three Miocene species, which ought to throw light on the problem. At any rate they show that the variation is of long standing.

Two fossil species with thirteen dorsal species, *Rixator porteousi* and *R. ineziæ*, related to *Sebastodes goodei*, have, like the latter species, twenty-four vertebræ, besides the last one which supports the hypural. This is evidence so far as it goes that the smaller number (with greater individual development of the bones) is very ancient. Nearly all the spiny-rayed shore fishes of the present day have twenty-five.

But another fish of this type—also Miocene (*Sebastavus vertebralis*), has thirty-two vertebræ. The relation of this species to existing forms is not close, nor is it well made out. All three of these Miocene species are found in deposits made in shallow, sheltered bays, in a temperate climate. As Mr. Huntsman observes, "A fruitful field for investigation is open in this direction." It should apparently involve both embryology and paleontology, as well as the study of adult fishes and their distribution.

DAVID STARR JORDAN

ABSTRACTS AND TITLES OF SCIENTIFIC ARTICLES FROM THE LIBRARIAN'S STANDPOINT

TO THE EDITOR OF SCIENCE: In his article on "Scientific Abstracting" in SCIENCE for ··ber 30, Mr. Fulcher emphasizes the point that the time of research men should be conserved for their actual research by facilitating for them in every way the securing of the scientific information already published. No one would dispute this statement, and its truth is becoming increasingly striking as the mass of literature yearly accumulates, but it is suggested that from his list of the agencies contributing to this end as a part of what he calls "our scientific information service" Mr. Fulcher has omitted a very necessary and important agency, namely, the scientific library. A library of a scientific institution has no other purpose than to collect and make available the literature on the subjects of interest to that institution, and anything which facilitates this work is ultimately of benefit to the investigators. There is no one to whom abstracts such as those pled for by Mr. Fulcher would be of greater help than to the scientific librarian or bibliographer. As he points out, it is impossible to rely on titles alone to show the variety of information contained in an article, so that it is necessary for a librarian compiling a subject catalogue to glance through each article so that he may be sure it is entered under all the subjects of which it treats. Abstracts in the form described, with the italicized paragraph headings and subtitles would suggest at a glance possible subject headings, and in the case of articles in highly specialized subjects would frequently suggest headings which, without the abstract, only the specialist would recognize as being desirable.

Speaking of this, the present writer has thought for a long time that it would be well for persons interested in increased economy and efficiency in the recording of scientific data to give the form of titles for periodical articles careful consideration. No title can, of course, describe all the contents of an article, but many could easily be more de-

scriptive than they are and contain information essential to a cataloguer or investigator, frequently obviating the necessity of an examination of the article itself to discover what it is really about. Take, for instance, titles like the following: "A spot disease of cauliflower," "Known species of smut on a new host," "A dangerous potato disease." Each of these titles shows in a general way what the article in question is about, but no one of them gives information essential for assigning subject headings, yet in each case this might have been done, still keeping the title concise and short. The title "A spot disease of cauliflower" omits the very important information that this is a new disease assigned to a new bacterial pathogene which is described in the paper, while "A spot disease of cauliflower caused by *Bacterium maculicolum* n. sp." gives the essential information and is not objectionably long. The title "Known species of smut on a new host" might much better be written "*Cintractia leucoderma* on a new host, *Cyperus gatesii*," and "A dangerous potato disease"—"A dangerous potato disease due to *Rhizoctonia violacea*" or "A dangerous *Rhizoctonia* disease of potatoes."

It may be difficult to assign satisfactory titles for articles on abstract subjects whose terminology is not definitely fixed, but in cases such as those mentioned above it is a simple matter to compose a clear and definite title giving the specific facts dealt with in the paper. The more definite titles would save time in the library not only in cataloging and bibliographical work, but would frequently prevent the necessity of the library's procuring a journal for an investigator on the chance that an article contained therein, whose title may have been seen in a catalog or list, may be on a subject in which he is interested. A clear and definite title shows at a glance whether the article should be read by an investigator working on a certain subject, while an ambiguous or indefinite title puts him under the necessity of looking up many articles only to find that they are not on his subject.

It would seem, therefore, well worth while for the National Research Council, or whatever agency is formulating the directions and rules for the preparation of analytic abstracts, to include with these directions for the preparation of titles for scientific articles. There are many points in addition to those which have been mentioned here, which should be considered, such as, for instance, the relation of the title of a preliminary abstract to the title of the complete paper appearing later, giving the same article in different journals different titles, the publishing of different articles on the same subject with identical titles, or, the continuation of an article with a title different from that of the first installment.

Eunice R. Oberly

Library, Bureau of Plant Industry,
U. S. Department of Agriculture

LONGITUDINAL ELECTROMAGNETIC FORCES

To the Editor of Science: Last spring the writer sent a note to one of our well-known and carefully edited scientific journals for its correspondence column, announcing briefly that there are a number of good reasons for concluding that the old belief (expressed by Maxwell) that electromagnetic forces can act only perpendicularly to a conductor and never in the direction of its axis, seems to be wrong, and if so, it should be corrected.

The "advisers" of the editor on subjects pertaining to physics, recommended that the note "ought not to be published" as it was "so subversive of long-established principles." Five weeks later, the editor returned the note unpublished.

Physicists who have a more progressive spirit and may, therefore, be interested in such "heresies," and who are not hide-bound by beliefs whose chief qualification is the age of those beliefs, will find this subject more fully discussed by the writer in an article in the *Journal of the Franklin Institute* for November. This is also a carefully edited scientific journal, and one of its "advisers" on physical subjects (one of our leading physicists) recommended that "it is well worth publishing."

Thirteen years ago, the writer described an experiment in which the result was the direct opposite to that called for by reading on it one of the most prominent of the laws stated by Maxwell. The proposed paper describing it was rejected by one of our leading societies on the ground that if true (which was very easily demonstrated) it was such a serious matter to refute one of Maxwell's laws that it ought to be kept a secret! It is needless to say that the writer published it; broad-minded electro-physicists have accepted this correction of that law.

Let us hope that our younger physicists will be more progressive and will develop the true scientific spirit of desiring to be corrected when it can be shown that what they teach their students is wrong.

CARL HERING

PHILADELPHIA,
November 1, 1921

THE SCIENTIFIC BUREAUS OF THE GOVERNMENT

TO THE EDITOR OF SCIENCE: Since my return to Washington from my summer's field work my attention has been called several times to circulars which have been sent broadcast throughout the country by Mr. Arthur MacDonald, The Congressional, Washington, D.C., recommending the reorganization of all of the government scientific bureaus under the direction of the Smithsonian Institution. While the institution appreciates the confidence in it implied by his suggestion, I desire to point out that his scheme is entirely impracticable and was not suggested or authorized by the Smithsonian Institution, with which Mr. MacDonald is not connected in any way.

I shall be glad if you will have the goodness to publish the above in SCIENCE, in order that your readers may understand thoroughly that the institution is in no way responsible for this propaganda.

CHARLES D. WALCOTT,
Secretary

THE SMITHSONIAN INSTITUTION,
November 5, 1921

QUOTATIONS

MEETING OF THE AMERICAN ASSOCIATION IN CANADA

THE American Association for the Advancement of Science is to hold its annual meeting in Toronto this winter. The rules of the association, recently revised, give the term "American" a Continental instead of a national connotation, so that the visit to Canada will be regarded as a normal rather than as an extra-territorial event. There is thus a departure from the constitutional precedent of the British Association and of its French and German parallels. These bodies are national, although they welcome foreign guests, and have occasionally paid visits to foreign countries. Were the matter political, difficult questions might arise with regard to the proposed visit of the British Association to Toronto in 1924. The former visits of the British Association to Montreal and Toronto, and later to South Africa and Australia, were regarded as not different in kind from visits to Edinburgh or to Bournemouth. The formation since then of a South African Association for the Advancement of Science would certainly not place any obstacle in the way of another British visit to the Cape. The inclusion of Canada in the American sphere similarly should not affect the prospects of future visits of the British Association. It is all to the good that science should prefer geographical to political frontiers. We confess to a feeling of envy, however, when we read of the concessions made by American railways to science. The utmost efforts failed to extract from the British railways such reductions in fare to members of the British Association going to Edinburgh as they readily concede to pleasure parties and week-end excursions. The railroads of America are acting differently. Reduced rates for visitors to the Toronto meeting have been granted by all the railways of Canada and by those covering practically all the New England and Atlantic Coast States down to Virginia, and by those serving Ohio, Indiana, Michigan, and Illinois. Other concessions are expected, and so far as the railway journey

is concerned, scientific men throughout the vast continent will be given every inducement to attend the Toronto meeting.—*The London Times.*

SCIENTIFIC BOOKS

Text-Book of Geology. By Amadeus W. Grabau. Two volumes. Part 1, General Geology, 864 pages, 734 text figures; Part 2, Historical Geology, 976 pages, 1980 text figures. D. C. Heath & Co.

A text-book in science may be written, like other books, for name and fame; or to set forth new truth; or for desired remuneration (which may be in inverse ratio to value); or simply because the author can not help it. This latest ambitious addition to geologic literature is another expression of the mental activity and scientific industry of the author, as it is his third important and voluminous work within a few years. In 1909–1910 he published, in conjunction with H. W. Shimer, two handsome volumes on "North American Index Fossils," covering only the invertebrates, with 1762 pages and profusely illustrated. In 1913 he produced another original work, "Principles of Stratigraphy," with 1185 pages. This latest, if less original, work is even more voluminous.

Facing the writer are several shelves filled with the antiques of English and American geologic literature, text-books and treatises dating back to the early part of the last century. The striking comparison between the old and new invites a brief homily on the development of American geology, as illustrated by the text-books.

These oldest books are amusing and pitiful in their diminutive size, narrow scope, queer ideas, and their occasional illustrations of exceeding crudity. If Science admitted pictorial illustrations a comparison of the old cuts with modern engravings of the same subjects would show the progress of graphic art. The older books antedate photography, which has been the greatest aid in study of nature.

Many of the old books have a theologic flavor, and some close with a pious exhortation. Beginning with Leibnitz (1646–1716) the writers sought to harmonize the facts of the new science with ancient Hebrew philosophy, and in particular tried to prove that Moses really meant "day" when he wrote it (in English). While there are yet people who give to old Hebrew literature more credence than to modern science, the time has gone by when American authors of scientific works have to defer to superstition.

Geology as a recognized branch of study in the schools is less than a century old. As a systemized branch of science and a part of general culture of the educated man geology began with Charles Lyell. His masterly writings (1830–1857) proved the continuity [illegible]ogic processes and set the standard for geologic literature. Previous to about 1840 American students relied chiefly on English works, or on American reprints. As late as 1837 Edward Hitchcock republished Dela-Beche's "Researches in Theoretic Geology," a small octavo of 342 pages and with no illustrations.

The oldest American text-book in this file is a little duodecimo of 122 pages, with 17 pages of index and errata, by W. W. Mather, entitled "Elements of Geology for the use of Schools," date 1833. This has a very few small diagrammatic illustrations. The writer's copy has pasted in the front cover a printed commendation by B. Silliman, of date June 18, 1834.

Two other old books are "Outlines of Geology," 1837, 384 pages, by J. L. Comstock; "Elements of Geology," by Charles A. Lee, 1839, 375 pages.

The second period of American geologic literature (1841–1860) began with Edward Hitchcock's "Elementary Geology," 1841. For two decades this was the American authority, and by 1860 it had run to the 30th edition, with 424 pages. The publication of a number of volumes by other authors suggests the stimulus to scientific study. Three of these had the favorite title "Elements of Geology"; by Samuel St John, 1851 (334 pp.); Justin R. Loomis, 1852 (198 pp.); Ayonzo Gray and C. B. Adams, 1853 (354

pp.). "A familiar Compend of Geology" of 150 pages by A. M. Hillside is dated 1859.

The contents of these old books usually justify the modesty of their titles.

The third period of text-book evolution (1860–1904) began with Ebenezer Emmons's "Manual of Geology," 1860. This had only 297 pages, but included many illustrations. Indeed, this was the first book to make very large use of illustrations.

But in a few years Emmons's excellent work and the other books were displaced by the masterly "Manual of Geology" by James D. Dana. This was true to its title, for that time. The first edition, 1862, had 798 pages and 984 illustrations. The fourth edition, in 1895, had 1087 pages and 1575 illustrations. All the geologists of the period including the older geologists now living were "brought up" on Dana's Manual. To meet the demand for a small text Dana published in 1863 his "Text-Book," which was revised in 1897 by W. N. Rice.

The most popular work during this period for class-room use and as a treatise for general reading was Joseph LeConte's "Elements of Geology," first published in 1878. In LeConte's picturesque style, with profuse new illustrations, and emphasizing mountain structure and other features of the western part of the continent, it held the field for three decades, with several revisions; and it is yet in demand, although badly out of date on many topics. LeConte's "Compend," with 399 pages, appeared in 1884.

During the later years of this period several smaller texts appeared; by N. S. Shaler, "First Book in Geology," 1884 (255 pp.); Angelo Heilprin, "The Earth and Its Story," 1896 (267 pp.); R. S. Tarr, "Elementary Geology," 1897 (499 pp.); W. B. Scott, "An Introduction to Geology," 1897 (573 pp.). Some popular works or treatises were: Louis Agassiz, "Geological Sketches," 1866; Alexander Winchell, "Sketches of Creation," 1870; "Sparks from a Geologist's Hammer," 1870; "World Life, or Comparative Geology," 1883; T. Sterry Hunt, "Chemical and Geological Essays," 1875; J. W. Dawson, "The Story of the Earth and Man," 1873; N. S. Shaler, "Aspects of the Earth," 1889.

The year 1888 marks an epoch in American geology, in the organization of the Geological Society of America, and the beginning of a periodical devoted entirely to geology. The *American Geologist* was founded and conducted by N. H. Winchell and existed to 1905, making 36 volumes. The *Journal of Geology,* published by the University of Chicago, began its excellent work in 1893.

The next commanding work, in succession to Hitchcock, Dana and LeConte, was the three volumes of T. C. Chamberlin and R. D. Salisbury, in 1904–1906, aggregating 2,000 pages. This may be regarded as introducing the fourth and present period of American geologic literature.

Other excellent text-books of later years are the following, omitting titles; J. C. Branner, (a syllabus) 1902; W. H. Norton, 1905; Eliot Blackwelder and H. H. Barrows, 1911; Chamberlin and Salisbury (single volume), 1914; L. V. Pirsson and Charles Schuchert, 1915 (1051 pp., 522 figures); W. J. Miller, 1916 (covering only historical geology); H. F. Cleland, 1916.

The above relates only to general geology, but the volume of earth-science literature has been increased by superior text-books in economic or industrial geology, and in physiography. The great mass of publication by the national and state surveys does not belong in this review.

Recurring now to the work in hand; it is in many respects an excellent presentation of geology to date. The writer has good literary style, direct and lucid. Most topics are well handled and many are treated with fullness and in a masterly way. This is especially true of sedimentation problems, of paleozoic stratigraphy, and of the historical part in general.

The illustrations are profuse and usually pertinent. The portraits of eminent geologists of former times will give the student a more lively human element. The paleogeographic maps, in Part II., are drawn in clear outline, and interesting comparison will be

made with the maps by Schuchert, and by Chamberlin and Salisbury. Some of the old and crude woodcuts that have done service in the literature for over half a century might be honorably retired; for example, Figs. 79, 128, 311, 593.

The publisher's part has been well done. More care in the matter of ink and presswork might improve the quality of the halftones, some of which are poor.

In the order of topics the author does not follow the usual practise of beginning with description of geologic processes open to observation, surficial geology, but uses the philosophical or deductive order of cause and effect. Three short chapters on the nature and scope of the science are succeeded by chapters on the materials composing the earth's crust, mineralogic and chemic geology, and volcanism. This is discussed in the interesting preface.

The many subjects in dynamic and structural geology are covered in the remaining 14 chapters of Part I.; the author's more original matter being on saline deposits (Chapter 11); organic deposits (Chapters 12, 13); and on the deposition, classification and structure of the clastic rocks (Chapters 16–18).

Historical Geology, Part II., does not offer much opportunity for any original treatment. The life history of the past is well emphasized.

The author is strong on classification and terminology, and in consequence of his refined classification some topics are subdivided and treated under different heads. For example, glaciers are discussed in at least four places in the first volume. The student who wishes to find what the book contains on a subject may have to consult the index many times.

A favorite subject of the author is the problems of sedimentation; marine transgression and regression, overlap and offlap, origin of saline deposits, etc. He discusses these in a masterly way. But he does not clearly distinguish between accepted fact and his own plausible philosophy. An elementary text-book in science should contain very little beyond established fact and generally accepted principles. In a comprehensive work like this, intended for advanced students, new theories and perhaps even subjects under sharp discussion may be admitted, but such should be distinctly stated as tentative. This matter needs to be specially guarded by an author who is active in scientific debate. It will be recognized as bad form for an author to use a text-book for propaganda. Students should realize that scientific truth comes by observation and experiment, not by mere thinking. Theorizing is helpful as it points the way for induction. Grabau's discussion of sedimentation, especially as it relates to Paleozoic stratigraphy, will provoke debate and will be stimulating to advanced students.

The work makes very large use of foreign material and of illustrations from foreign literature. Indeed, on many topics the description of foreign features and phenomena is in excess. The work should be a satisfactory text for European students. But American students will be disappointed in the meager discussion and illustration of some interesting features of American geology. Some topics having very inadequate treatment, as noted in the rapid review, are: American geysers with only a few words, but four pages, including four cuts, of geysers in general; two pages on petroleum and rock gas; the glacial lakes and tilted shorelines in the basin of the Great Lakes and the Hudson-Champlain valley receive only a few lines (page 695); only three pages on coal; only four lines to drumlins.

What may be regarded as a defect in the work is the entire absence of references to the geologic literature. Some reference to the more important articles on topics only briefly discussed in the work would be very useful to the reader. And for subjects on which other authorities may differ references to the literature are necessary for impartial study.

The work is too full and too large to be used as a text for beginners. The author evidently had laboratory use in mind. Only the test of actual use can prove its value in competition with other excellent works. The time has passed when all of geologic general science, even for our continent, can be usefully gathered into one or two volumes. That was fairly done by Dana, fifty years ago. Fifteen years ago Chamberlin & Salisbury had to make three

volumes. A present-day book for beginners should contain little more than the basal principles and the more striking and interesting facts and illustrations. For advanced work special treatises on separate branches of the science are desirable. Already the economic or industrial geology has been divorced from general study. The same is true for earth forms or physiography; and partially for paleontology. Further differentiation may cover dynamics and geophysics; surficial processes; sedimentation and structure; meteorologic and glacial geology; with perhaps later division of the historical.

Grabau is now in China, as professor of paleontology in the University of Peking, and Paleontologist to the Chinese Geological Survey, and we may anticipate further enrichment of geologic literature from his prolific and facile pen.

H. L. FAIRCHILD

SPECIAL ARTICLES

A PRECISION DETERMINATION OF THE DIMENSIONS OF THE UNIT CRYSTAL OF ROCK SALT

ALL measurements of X-ray wave-lengths and of crystal structures depend upon the solution of the atomic marshalling of some crystal and a calculation of the dimensions of the fundamental unit of that crystal in terms of its mass and density. The crystal most used in this connection is rock salt (NaCl). It is the purpose of this note to give the side of the unit cube of NaCl in terms of the most accurate data available.

The NaCl crystal was early shown by Bragg to be a cube, alternate corners of which are occupied by Na, the remaining corners being occupied by Cl. Since one half of one Na and one half of one Cl are each associated with one unit cube, the mass of the unit must be

$$1/2\,[A_{\mathrm{Na}} + A_{\mathrm{Cl}}]\,m,$$

where A_{Na} is the atomic weight of Na,
A_{Cl} is the atomic weight of Cl,
m is the mass in grams associated with one unit of atomic weight.

The 1919 International Table of Atomic Weights gives

$$A_{\mathrm{Na}} = 23.00$$
$$A_{\mathrm{Cl}} = 35.46$$

If these values should be wrong by .01 the error would be less than .05 per cent. in each case.

m is most easily found as e/F where e is the charge on the electron, F is the Faraday constant in electrolysis. Millikan[1] gives e as 4.774×10^{-10} Abs. E. S. units of charge with a maximum error of .1 per cent.

This gives $e = \log^{-1} \overline{19}.20176$
$= 1.591 \times 10^{-19}$ absolute coulombs.

Vinal and Bates,[2] of the Bureau of Standards give

F (Iodine) $= 96{,}515$
(Silver) $= 96{,}494$

Mean $= 96{,}505$ international coulombs.

They have determined the absolute coulomb as being .004 per cent. greater than the international coulomb, and recommend the value in absolute coulombs,

$$F = 96{,}500$$

The maximum error is .01 per cent.

From the above

$$m = e/F = \log^{-1} \overline{24}.21723$$
$$= 1.649 \times 10^{-24} \text{ gms.}$$

The density of NaCl is given by Zehnder (1886) as 2.188, by Retgers (1890) as 1.167, by Krickmeyer (1896) as 2.174 and by Gossner (1904) as 2.173. Gossner's work[3] seems to have been done with special care. He measured eleven artificial crystals of NaCl, obtaining densities ranging from 2.171 to 2.175. His measurements on natural crystals gave 2.173. Taking these results in connection with those of Krickmeyer, we may assign to NaCl a density of $2.173 \pm .002$, thus giving a maximum

[1] R. A. Millikan, "A new determination of *E, N*, and related constants," *Phil. Mag., 34*, 1917.

[2] G. W. Vinal and S. J. Bates, "Comparison of the silver and iodine voltameters, and the determination of the value of the Faraday," *Bull. Bureau of Standards, 10*, 425, 1914.

[3] B. Gossner, "Untersuchung polymorpher Körper," *Zeit. f. Kryst., 38*, 132, 1904

error of .1 per cent. It should be understood that this density refers to measurements at room temperature. The coefficient of expansion of NaCl is given by the Smithsonian Tables as $.40 \times 10^{-4}$, so that a variation of 10° C. in either direction from normal room temperature would make an error of less than .05 per cent. in the side of the cube.

The volume of the unit cube of NaCl is therefore

$$V = \frac{\text{Mass}}{\text{Density}} = \log^{-1} \overline{23}.34600$$
$$= 22.182 \times 10^{-24} \text{ cc.}$$

and the side of the unit cube is

$$d = \log^{-1} \overline{8}.44867$$
$$= 2.810 \times 10^{-8} \text{ cm.}$$

Even if all the values entering into this result were in error to the maximum amount, and all in such a direction as to affect the final result in the same sense, the change in the value of d would be less than .1 per cent.

For purposes of reference, the table below gives the logarithms of the interplanar distances of a simple cube of side $\log^{-1} .44867$ and the actual distances to three decimal places. These lines are all found in the powder diffraction pattern of NaCl. The additional lines of the face-centered cube of Cl ions ($d = 5.620$) are not included in the table as they are too faint to measure easily on a film and are therefore useless for calibration purposes.

Plane	Log Distance	Distance
100	.44867	2.810
110	.29816	1.987
111	.21011	1.622
100 (2)	.14764	1.405
210	.09919	1.257
211	.05960	1.147
110 (2)	$\overline{1}.99713$	.993
{ 211, 100 (3)	$\overline{1}.97115$	.936
310	$\overline{1}.94867$	.889
311	$\overline{1}.92798$	.847
111 (2)	$\overline{1}.90908$	.811
320	$\overline{1}.89170$	.779
321	$\overline{1}.87561$	.751
100 (4)	$\overline{1}.84661$	.702
{ 410, 322	$\overline{1}.83345$	.681
{ 411, 110 (3)	$\overline{1}.82104$	.662
331	$\overline{1}.80930$	.645
210 (2)	$\overline{1}.79816$	.628
421	$\overline{1}.78756$	.613
332	$\overline{1}.77746$	.599
211 (2)	$\overline{1}.75857$	.574
{ 430, 100 (5)	$\overline{1}.74970$	.562

WHEELER P. DAVEY
GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y.

THE AMERICAN ELECTROCHEMICAL SOCIETY

SOCIAL EVENTS, LECTURES

It was generally conceded by all in attendance at Lake Placid that a most unique meeting place had been selected for a Fall meeting. Through the courtesy of the Lake Placid Club their recreation facilities were placed at the disposal of our members and afforded excellent opportunities for taking part in golf, tennis, motoring and mountain hiking.

A great deal of the success of the meeting is due to Mr. W. M. Corse, who spared no effort as acting chairman of the arrangements committee.

On Thursday, September 29, at 9 A.M., the fortieth General Meeting of the Society was called to order by President Acheson Smith, who then introduced Dr. Melvil Dewey, founder and president of the Lake Placid Club. Dr. Dewey cordially welcomed our members and mentioned several points of interest that everyone should see while at Lake Placid. The reading and active discussion of papers followed this talk and were continued in the mornings of the next two days, the features of which were respectively the symposiums on Non-ferrous Metallurgy and Electrodeposition.

The boat ride, on Thursday afternoon, comprising a round trip on Lake Placid, was enjoyed by each of the 48 persons on board.

A brief history of the Lake Placid Club was outlined by Dr. Dewey in a short talk preceding the lecture on "Chemistry and the Stars" by Professor Harlow Shapley. With the aid of lantern slides Professor Shapley presented a very interesting account of the stellar universe and of the work being done at the Mt. Wilson Observatory.

Friday afternoon. A mountain hike up Mt. MacIntyre was a thrilling experience for all in the party. The club lodge at the base of this peak was reached by motor car through 10 miles of winding roads. An unusual rain storm prevailed before the party had reached the halfway mark, but this was

no obstacle in the way of seven or eight who finally succeeded in reaching the summit.

On Friday evening Dr. Dewey gave a number of illustrations on "How English can be made the world language by removing the chief obstacle in learning it." This talk was followed by an illustrated lecture on "The practise of forestry on national forests," by Col. T. S. Woolsey. Col. Woolsey has been connected with U. S. Forest Service and his various slides were very interesting.

Mr. Arthur Delroy very cleverly explained how character is read from hands and handwriting, and gave illustrations of how the "impossible" or magic trick was performed on the stage.

Later in the evening an informal dance closed the social events of the meeting.

TECHNICAL SESSIONS

Each of the three technical sessions was attended by a number of members and guests who took active part in discussing the papers presented. The result was that the proceedings, carried out according to schedule, were lively as well as interesting.

The Thursday morning session was filled by reading and discussion of papers:

Experiences with alkaline and alkaline earth metals in connection with non-ferrous alloys: CHARLES VICKERS. Sodium appears to have a negative value for copper, but seems to be superior to phosphorus in deoxidizing bronze. Calcium, of the alkaline earth metals, appears valueless in producing sound copper castings. As a deoxidizer, calcium is best adaptable when combined with an acid element, as silicon, and is further improved when combined with a third element.

The electrolytically produced calcium-barium-lead alloys comprising Frary metal: W. A. COWAN, L. D. SIMPKINS and G. O. HIERS. This paper presented by Mr. Hiers described the development of Frary Metal and its production by electrodeposition from a mixture of calcium and barium chlorides over a bath of molten lead as cathode. The properties of Frary metal are compared with those of other bearing metals. As a bearing metal it has desirable hardness and strength at elevated temperatures.

The electrolytic corrosion of lead-thallium alloys: COLIN G. FINK and C. H. ELDRIDGE. Presented by DR. FINK. Anodic corrosion losses in an acid copper sulfate electrolyte containing nitric and hydrochloric acids are reduced by using lead-thallium alloys. A minimum loss of 1.2 lb. per 100 lb. of copper deposited resulted with a lead anode containing 10 per cent. Tl and 20 per cent. Sn.

A new theory of the corrosion of iron: J. NEWTON FRIEND. An auto-colloidal catalytic theory, which postulates the corrosion as starting by the formation of colloidal ferrous hydroxide. This by contact with the air forms hydrated ferric hydroxide which in turn is alternately reduced by contact with iron and oxidized by contact with air, thus continuing the corrosion.

Rust prevention by slushing: HAAKON STYRI. An extended research which shows that for protection against rust by greases a thorough cleaning of the steel parts by an aqueous solution is essential; an oil emulsion which leaves an oil film for short time protection is preferable. Such emulsions protect against rust.

Transformer oil sludge: C. J. RODMAN. Of the three types of transformer oil sludge (asphaltic, soap and carbon), the asphaltic is the most general form and is the oxidation product of an attackable oil. It collects upon the active parts of transformer. The soap sludge forms slowly and is difficult to remove by filtration. The carbon sludge is caused by electrical breakdown.

The electrolysis of organic compounds: RAYMOND FREAS. The author endeavors to encourage further research of organic compound electrolysis. The discussion, limited to electro-reduction processes, presents the factors influencing the relative velocities of reaction, and despite their great number it is maintained possible to secure selective reduction electrolytically. A convenient experimental arrangement is described.

Electrolytic oxidation of the leuco-base of malachite green: ALEX. LOWY and E. H. HAUX. That the dye stuff malachite green can be produced by electrolytic oxidation of the leuco-base is set forth in a series of experiments. The highest dye yield resulted with uranyl sulphate as catalyst, platinum cathode, and nichrome gauze anode in dilute sulphuric acid solution, at 85° C.

The electrolytic dissociation of cyanamide and some of its salts in aqueous solution: N. KAMEYAMA. The degree of dissociation and of hydrolysis of sodium and calcium cyanamide was determined; from this the dissociation constant was calculated and the mobility of the cyanamide anion estimated.

Electrolytic production of sodium perborate: P. C. ALSGAARD. After presenting a detailed account of the work by Arndt and by Valeur, the author relates the results of his experiments and their application to larger scale production.

The electrolytic oxidation of hydrochloric acid to perchloric acid: H. M. Goodwin and E. C. Walker. The investigation and data present the effect of acid concentration, current density, duration of electrolysis and temperature on the yield of perchloric acid. A cell yielding 800 grams of 60 per cent. acid per 24 hours is described.

Graphic control of electrolytic processes: B. G. Worth. A graphic method of maintaining fixed conditions in potassium chlorate production is presented. Of the three factors which influence the yield, two represent concentrations of 2 compounds one of which is controllable by addition agents, and the third is temperature.

Friday morning was devoted to a Symposium on Non-ferrous Metallurgy. The papers included were:

The influence of the electric furnace on the metallurgy of non-ferrous metals: H. M. St. John. The use of the electric furnace in brass foundries and refining plants for melting purposes has revolutionized metal handling methods; a more uniform quality of product is obtained with less labor and less metal wastage. The attainments are better than have been previously possible and the secretiveness which has been characteristic of the non-ferrous industry is gradually being done away with.

Modern developments in the British brass industry: E. A. Smith. The actual condition of the British brass industry is presented with a discussion of electric brass furnaces, hot pressing and forging in brass, rolling mill practice, annealing, etc.

Resistance type of electric furnace in the melting of brass and other non-ferrous metals: T. F. Baily. The various features to be considered in making an electric furnace installation for melting non-ferrous metals are discussed.

Comparison of electric furnace practise with fuel-fired furnace practise: N. K. B. Patch. The author's experiences are that the cost of metal melted, the melting losses, and the solution of gases in metal, are substantially the same in the electric and the fuel-fired furnace, providing intelligent operation is pursued.

Electric silver melting: H. A. DeFries. Describes advantages of electric furnace melting of silver and relates how a more ductile and tougher silver results upon introducing an iron block into the bath.

Electric furnace melting of nickel-silver: F. C. Thompson. Advantages of melting nickel-silver in the externally heated electric furnace are discussed.

Aluminum-copper alloys: R. J. Anderson. A discussion of the manufacture, properties and uses of the commercial aluminum-copper alloys employed in the United States.

Recent developments in electric furnaces of the muffled arc type: H. A. Winne. Several types of muffled arc melting furnaces are described with their features and adaptabilities.

Electric furnace purification of zirkite: J. G. Thompson. The arc type furnace used in this investigation made it possible to remove 90–95 per cent. Si as an impurity from the zirkite ore; the amount of carbon introduced being only sufficient to transform the silicon to the carbide.

Physical characteristics of specialized refractories. Cross breaking strength at 20° and 1350° C.: M. L. Hartman and W. A. Koehler. The tests were carried out on each of ten refractory materials at the temperatures indicated.

An Electrodeposition Symposium was the feature of the morning of the closing day of the meeting, Saturday, October 1. The papers discussed were:

An electric steam-generator for low voltage: F. A. Lidbury and F. A. Stamps. An inexpensive form of apparatus for the generation of steam by means of an alternating current of voltages from 100 to 500.

The effect of pressure on overvoltage: H. M. Goodwin and L. A. Wilson. The values of overvoltage of hydrogen against copper, nickel and mercury electrodes were determined at pressures varying from one atmosphere to a few centimeters of mercury.

Researches on the electrodeposition of iron: W. E. Hughes. The results of several experiments and those obtained by the author are related in the electrodeposition of iron from (1) sulphate solutions, (2) chloride solutions and (3) sulphate-chloride solutions.

Electrolytic solution and deposition of copper: T. R. Briggs.

Electrometallurgy of zinc: W. R. Ingalls. The developments in the electrolytic zinc extraction process and the progress, in Scandinavia, of electrothermic smelting are set forth.

Deposition of zinc from the zinc cyanide solution: C. J. Wernlund. This research was carried out with the intention of obtaining a zinc cyanide plating solution which would operate successfully under the most trying commercial conditions.

The electrodeposition of lead-tin alloys: Wm. Blum and H. E. Haring. That a finer grained de-

posit of alloys of lead and tin can be obtained from fluoborate solutions than is possible when depositing either of the metals under similar conditions is established.

The structure and properties of alternately electro-deposited metals: WM. BLUM. If during the deposition of copper thin layers of nickel are interposed, a deposit of greater tensile strength than pure copper results due to the restraining influence nickel has on the growth of copper crystals.

In all the meeting proved to be most profitable, social and instructive.

A. D. SPILLMAN,
Secretary

THE OPTICAL SOCIETY OF AMERICA

HELMHOLTZ MEMORIAL MEETING

THE sixth meeting of the Optical Society of America was held in Rochester, N. Y., October 24, 25, 26, 1921. 113 persons were registered in attendance. The attendance at various sessions varied from about 35 to 100 or more.

The most notable feature of the meeting was the Helmholtz Memorial Meeting held on the afternoon and evening of Monday, October 24. The following former students of Helmholtz were present: Professor Henry Crew, Professor C. R. Mann, Professor Ernest Merritt, Professor E. L. Nichols, Professor M. I. Pupin, Dr. Ludwik Silberstein. The afternoon program was as follows:

A brief survey of the historical development of optical science: PROFESSOR J. P. C. SOUTHALL.

Helmholtz's early work in physics—the conservation of energy: PROFESSOR HENRY CREW.

Helmholtz's contributions to physiological optics: L. T. TROLAND.

Professor Crew exhibited lantern slides showing Helmholtz at the time he wrote the essay on the Conservation of Energy (age 26) and also at later periods of his life.

At the evening session Professor M. I. Pupin spoke informally and in most interesting and delightful manner on his Personal Recollections of Helmholtz. Professor E. L. Nichols, Professor Ernest Merritt, Dr. Ludwik Silberstein, Mrs. Christine Ladd-Franklin and Professor C. R. Mann also spoke of their memories of Helmholtz as a teacher. Professor Mann showed a lantern slide of a photograph which he himself made on July 7, 1894, showing Helmholtz at his lecture desk only a few days before his last illness.

The Helmholtz Memorial addresses will be published in the Journal of the Optical Society of America.

Various scientific societies were represented at the meeting by delegates as follows:

American Mathematical Society: Professor A. S. Gale.

American Physical Society: Professor M. I. Pupin, Dr. L. T. Troland, Professor Henry Crew.

American Association for the Advancement of Science: Professor M. I. Pupin.

New York Academy of Science: Professor M. I. Pupin.

American Academy of Ophthalmology and Oto-Laryngology: Dr. R. S. Lamb.

American Medical Association, Section of Ophthalmology: Dr. W. B. Lancaster.

American Ophthalmological Society: Dr. Lucien Howe, Dr. George S. Crampton.

Society of Illuminating Engineers: Dr. George S. Crampton.

American Psychological Association: Dr. L. T. Troland, Mr. Prentice Reeves, Professor C. E. Ferree, Dr. P. W. Cobb.

The following papers were presented at the regular sessions of the Society on October 25 and 26.

Photo-electric potentials from the retina: E. L. CHAFFEE AND W. T. BOVIE (to be published in full in the *Jour. Op. Soc. Am.*).

Intensity and composition of light and size of visual angle in relation to important ocular functions: C. E. FERREE AND GERTRUDE RAND.

A theory of intermittent vision: HERBERT E. IVES (to be published in full in the *Phil. Mag.*).

An analysis of the visibility curve in terms of the Weber-Fechner law and the least perceptible brightness: ENOCH KARRER (to be published in full in the *Jour. Op. Soc. Am.*).

A quantitative determination of the inherent saturation of spectral colors: L. T. TROLAND (to be published in full in the *Jour. Op. Soc. Am.*).

The interrelations of brilliance and chroma studied by a flicker technique: L. T. TROLAND AND C. H. LANGFORD (to be published in full in the *Jour. Op. Soc. Am.*).

A proposed standard method of colorimetry: HER-

bert E. Ives (to be published in full in the *Jour. Op. Soc. Am.*).

Accuracy in color matching: W. E. Forsythe (to be published in full in the *Jour. Op. Soc. Am.*).

Measurement of the color temperature of the more efficient artificial light sources by the method of rotatory dispersion: Irwin G. Priest (to be published in full in the *Jour. Op. Soc. Am.*).

The Blue Glow: E. L. Nichols and H. L. Howes (to be published in full in the *Jour. Op. Soc. Am.*).

The optical properties of a cylindrical enclosure with specularly reflecting walls: Herbert E. Ives.

The relation between glass and the deflection characteristics of surfaces: Lloyd A. Jones and M. F. Fillius (to be published in full in the *Jour. Op. Soc. Am.*).

The graininess of photographic materials: Lloyd A. Jones and Arthur C. Hardy (to be published in full in the *Jour. Frank. Inst.*).

The design of aspherical lens surfaces: P. G. Nutting.

On the distribution of light in planes above and below the image plane in the microscope: Fred E. Wright.

The factors underlying the measurement of refractive indices by the immersion method: Fred E. Wright (two preceding to be published in one paper in the *Jour. Op. Soc. Am.*).

Some thermal effects observed in chilled glass: A. Q. Tool and C. G. Eichlin.

A new X-Ray diffraction apparatus: Wheeler P. Davey (to be published in full in the *Jour. Op. Soc. Am.*).

Rotating photometric sectors of adjustable transmission while in motion: Carl W. Keuffel and C. D. Hillman (to be published in full in the *Jour. Op. Soc. Am.*).

Euscope: William G. Exton.

Turbibimeter: William G. Exton.

On Tuesday evening, October 25, visiting members were guests at a dinner entertainment given by the Rochester Section of the Society.

The very well conducted trips through the Research Laboratories of the Eastman Kodak Company and the glass plant, optical shops and observatory of Bausch and Lomb were also much appreciated by the visiting members.

The Rochester Section was given a hearty vote of thanks for its hospitality and the many courtesies extended during this very successful meeting.

Forty new members were elected. The membership is now about three hundred.

The Society's intention to cultivate actively the field of physiological optics was indicated by the following resolution, adopted October 26, 1921:

Whereas the Optical Society of America is devoted to the science of optics, pure and applied, a subdivision of which is the subject of Physiological Optics, with the several contributory sciences of physiology, psychology, physics and chemistry, representatives of which sciences have at the present time no common meeting ground for the discussion of problems of vision of mutual interest and

Whereas, the National Research Council, through its Committee on Physiological Optics, has recommended to the Optical Society of America the taking of such steps as may be necessary to further and encourage cooperative efforts in research in vision and allied phenomena, therefore be it

Resolved that the Optical Society of America does hereby signify its intention of devoting one or more sessions of each annual meeting to papers on Physiological Optics and other appropriate subjects related to vision, and

Resolved that there be and hereby is established by the Society a Standing Committee of three, the duty of which shall be

(1) To prepare the program of the sessions on Vision,

(2) To coordinate the work of the Society in this field with the work of other Societies and

(3) To recommend, from time to time, such further steps as may be deemed effective in encouraging research in Physiological Optics and allied problems. And

Resolved further that the Optical Society, through its Committee on Physiological Optics, shall invite all those interested in research on Vision and allied fields to participate actively in these sessions.

The next meeting will be held at the National Bureau of Standards in Washington in the latter part of October, 1922. It is tentatively planned to hold an exhibition of optical instruments in connection with this meeting.

Irwin G. Priest,
Secretary

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EDUCATION IN RELATION TO PUBLIC HEALTH AND MEDICAL PRACTISE[1]

PERHAPS the most obvious thing that can be said in regard to education in relation to matters of health and medical practise is that such education is sadly needed. I may state the matter rather more strongly by saying that ignorance on these subjects is directly responsible in the United States alone for the loss of several hundred thousand lives each year, and an amount of sickness and suffering which we can express in no adequate measure. Ignorance of the laws of health, of the causes of disease, of how to avoid epidemics; ignorance of how to take care of children in the perilous period of infancy; ignorance of how to secure the proper medical aid in case of sickness and of how to take care of one's self or dependents when ill,—ignorance in one form or another is probably the most potent of all the allies of the angel of death.

The maintenance of life, whether in man or in lower animals, always implies an adequate adjustment of the organism to its environment. Since relatively few human beings die of old age, most death can be attributed to failure to make the proper adjustments. Among the things that our organism has to guard against are enemies of various sorts, lack of the proper quantity and quality of food, vicissitudes of climate, accidents and diseases, and it is obvious that the more we know of the various agencies that cause people to die, the more successful we shall be in avoiding or overcoming them. If one goes over the most common causes of death enumerated in the U. S. Mortality Statistics, he can not fail to be impressed

[1] Read before the Symposium on Science and the Public Health, held under the auspices of the Pacific Division of the American Association for the Advancement of Science, Berkeley, Calif., Aug. 4, 1921.

with the fact that the things that make people die are to a large extent avoidable. Of course we must all die some time. But knowledge has enabled man to cut down very materially the death rate from many causes in the past few decades and with greater diffusion of knowledge it is perfectly possible to make tremendous strides further in the same direction.

It is not sufficient that this knowledge be in the hands of the medical profession merely, much as humanity in general might gain and has gained by the application of this information to the prevention and cure of disease. The general public must be enlightened in regard to the preservation of health if the knowledge in the possession of the medical world can be applied in the most effective way. Imperfectly developed as medical science may be at the present time, there is a tremendous amount of sickness and death that could be avoided if the great mass of humanity could avail itself of the resources of medical knowledge and skill that are now available. As Dr. Benjamin Moore says in his book "The Dawn of a Health Age" in speaking of conditions in England,

> At the present moment we possess sufficient knowledge of medical science to enable us to save at least three hundred thousand lives every year in this country alone, and the saving of these three hundred thousand valuable lives could all be effected without costing the nation a single penny, but rather at the same time many million pounds a year might be saved which under present conditions are absolutely wasted.

For this deplorable situation there are a number of causes, one of which is our commercialized system of private medical practise, but another is the widespread lack of information in regard to the preservation of health and the proper utilization of the medical aids within reach. But besides the drawbacks due merely to ignorance, there are others that are due to traditional modes of thought that have come down to us from the days of the primitive medicine man and which can not be properly appreciated except in the light of their historical development. We may no longer believe in sorcery and magic but numerous individuals are still swayed by various attenuated superstitions which may determine their conduct when matters of life or death hinge upon the correctness of their judgment. Most of us set little store by charms and amulets, but many are prone to look upon medicines as effecting cures in a quite mysterious way. Much mysticism and superstition still linger in popular notions of medicine. Cures are not infrequently attributed to supernatural interference, and the functions of priest and medicine man that were originally performed by the same person are by no means yet completely dissociated. The old theory of demoniacal possession as the cause of disease and the old practise of exorcising the intruding spirits in order to effect a cure still survive, in a modified form to be sure, but with easily recognizable marks of their descent. As a scientific theory of disease, by the way, this primitive belief has a decided advantage over some of its modern outgrowths in its relative simplicity and rationality if we once grant the demonological premise upon which it was founded. And on account of the recent recrudescence of animism in several quarters I rather look forward to its being revived.

There can be little doubt that the influence of old traditional notions is no small factor in determining the attitude of many people towards problems of health in the educated and the un-educated classes alike. Many people who may be perfectly scientific when it comes to matters of building bridges or repairing engines, may rush when ill to some quack of whose qualifications they know nothing, or adopt procedures as stupid as wearing a charm or repeating some mummery to ward off the evil eye.

We are losing our old-time naïve confidence in medicines and to a certain extent the medical profession. We know that doctors often disagree, that they continually make wrong diagnoses, that they have their fads in methods of treatment that spread like epidemics over the profession only to be abandoned after a short period of trial; people are dis-

turbed by the teachings of so-called schools with their different theories of the cause and cure of many diseases. And when they are ill they are puzzled to know where to go for relief. Smith recommends Dr. Jones; Brown advises an osteopath; someone else favors a Chinese herb doctor who is reputed to have made some wonderful cures; another suggests a favorite patent medicine; another urges the employment of an electric healer; still another extols the virtues of hydrotherapy; and Mrs. X. would have them go to a Christian Science healer to help overcome the illusion that there was anything the matter at all. Out of the thousands of things that have been prescribed and swallowed for various ailments a mere handful have stood the test of time and fuller experience. Almost any liberal-minded modern doctor will tell you this, but a large part of the public fails to appreciate how far the medical profession has advanced and still regards the doctor as chiefly a dispenser of dopes.

Not only is there much misconception of medical science and practise but there prevails a good deal of dissatisfaction and discouragement with medicine that is not devoid of substantial grounds. It can not be denied that our present commercialized medical practise prevents a large part of the public from obtaining the medical attention it needs and which, for the welfare of society in general, it should receive. As Dr. Cabot has remarked, the only persons who can afford adequate medical aid are the very poor (who are often taken care of for nothing) and the very rich. This circumstance doubtless leads many to become dissatisfied with medicine in general and renders them prone to be misled by the attacks of the enemies of medical science who seem to be growing in numbers in proportion as the science has advanced and its real service has become extended.

Among the large bewildered and dissatisfied class there are many who have gone from one doctor to another without ever falling into the right hands. There are many unfortunately for whom there is simply no help available in the present condition of medical science. And there is a large class of persons with imaginary ills who continually haunt the offices of doctors in the vain effort to obtain relief. All these classes are apt to furnish recruits to the opponents of medical research and practise who, whether from a semi-religious fanaticism or from motives of financial gain, make themselves a constant menace to the health of the community.

A large proportion even of educated people have no proper orientation upon the present situation of the science of medicine. What is particularly hard for them properly to realize is the difficulty of the problems which the physician has to solve and the extent to which he is handicapped by the failure of science to afford adequate methods of diagnosis and cure. The physician is continually confronted with problems the only honest answer to which is "I don't know." But his patients are naturally disappointed with such a verdict, even when assured that the doctor will take the necessary steps to get at the root of the trouble. Frequently patients can not be made to consider the situation in an unbiased manner and have no proper appreciation of a truly scientific attitude on the part of the physician. The demand of such patients to be humbugged often leads the physician to adopt an attitude of pretense and assurance in order to cheer up his patients and keep his business.

The remedy for this situation—and conditions in this regard have improved in recent years—is more scientific training on the part of doctors on the one hand and enlightening the public as to what may reasonably be expected of medicine on the other. Well-trained and high-minded physicians who treat their patients with entire candor and frankness even at the risk of alienating many of them do much toward educating the public to take the right attitude in turn toward the medical profession. With improvements in the standards of medical education and the elimination of the poorly equipped practitioner who is, perforce, something of a pretender, the esteem with which the medical profession is

regarded will surely rise and many causes of dissatisfaction which now alienate people will tend to disappear.

It is important that the public be made to realize that although medical practise is very old, scientific medicine is still in its infancy. The public should know something of the great conquests which have been made in recent years in the struggle against disease. It should know something of the rôle of bacteria in causing diseases, how diseases are spread, and consequently how they may be checked. It should have some knowledge of the achievements of protective inoculation, serum therapy, the relation of knowledge of physiology and pathology in understanding and treating disease, and the general dependence of medical science and practise on the development of the fundamental sciences on which medicine rests. It should appreciate that most of these sciences have had their greatest development in relatively recent times, that the cause of public health is dependent upon their further advancement, that we are living in a period of great achievement and promise, and that we may save millions of human lives and endless suffering by the support and encouragement of scientific research.

Unless the more educated part of the community have some vision of the development, present situation and promise of medical science, it is apt to be more strongly influenced by the shortcomings of present-day practise than by the wonderful achievements which medicine has actually won. But very recently in our own state, California, the educated public showed itself in danger of being misled into supporting legislation in the interests of quackery and even of fanatical opposition to medical research.

The public health is a public trust. If this trust is not discharged properly, the public will have to pay a fearful bill. The more informed the public becomes, the higher are the standards that will be demanded of those that practise the healing art, the more adequate will be the provisions for public hygiene and sanitation, the more satisfactory will be the relations of doctor and patient, and the more generously will investigation be supported. Even among educated people there is sore need of education along these lines.

But greatly as many educated people need educating, there is a frightful amount of suffering and needless death among the more ignorant elements of the community and especially among our large immigrant population. The recent book of Mr. M. J. Davis on "Immigrant Health and the Community" reveals a general situation that is very bad. Our great immigrant tide lodges mainly in cities where the various nationalities are segregated in crowded districts where they live under unhygienic conditions. Their death rate as shown by the U. S. Mortality Statistics and the investigations of a number of life insurance companies is markedly in excess of that of the native-born. Their infant mortality is high. The studies of the U. S. Children's Bureau have shown that in many towns it is two or even three times that of the native Americans, and that it tends to decrease with greater length of residence in this country. While a certain amount of the enhanced mortality of the foreign-born is due to their low economic status, a larger part of it is due to ignorance in regard to the maintenance of health. Many immigrants do not know English when they arrive and never learn it afterward. The newspapers printed in foreign languages,—and there are over 1,200 of them in the United States,—are full of the advertisements of quacks, it being a noteworthy fact that while such advertisements have decreased in papers published in English they have greatly increased in papers published in foreign languages. The uninstructed foreigner who does not distinguish between the regular physician and the advertising quack is swindled out of his money and fails to get competent aid when he is ill. Many belong to Benefit Societies and receive for a small fee the perfunctory service of some lodge doctor. Numbers frequent free clinics and dispensaries where they are rushed through a cursory examination and given a

bottle of something to allay their more distressing symptoms. All along the line the immigrant gets service which is scamped if he is not actually swindled by charlatans and quacks. The barrier of language prevents him from receiving that enlightenment on the subject of quackery which has done so much toward guarding the English reading public from being defrauded. The same barrier keeps him from securing needed aid from his English-speaking neighbors and in consequence of his ignorance and isolation death exacts a heavy toll.

Nothing can demonstrate more forcibly the importance of widespread education in relation to public health and medical practise than the unfortunate situation of many of our foreign-born population. And we should pay much more attention than heretofore to the problem of protecting these people against the results of their own ignorance and the ravages of unscrupulous charlatans.

But we need a much wider campaign of education. Naturally one thinks of the schools which should at least give more generally than they do, the elementary instruction in physiology and hygiene which would prepare the students, in a measure, for understanding many problems with which they will later have to cope. The Federal Government is making a small beginning in the way of instructing people through various publications on matters of public health and especially in the care of infants. Boards of Health in many cities are carrying on the work of education and this work could be easily extended. Papers and magazines may do much for the cause as is evinced by the articles of Dr. Wiley and the attacks of *Collier's Weekly* on various medical frauds. Life insurance companies are finding it to their interest to disseminate information on the preservation of health among their policyholders and even supply nurses to attend them during illness. The various societies affording sickness and accident benefits to their members would probably find it advantageous to give instruction about keeping well and thus save themselves from paying money to members after they are sick. So also with the large industrial firms which employ physicians and maintain hospitals for their employees. And the doctors themselves might consistently with their calling—for we should bear in mind that doctor means teacher—the doctors might do much more than they do in the way of educating the public on matters of health.

All of these agencies I have mentioned and more besides have to do with instructing the public and all of them could well do more. This task which as we have seen is of such vital importance for human welfare would be greatly facilitated if the medical profession stood in more helpful relations to its patrons. As it is, a large part of the time of well-trained medical men is simply wasted in a kind of desultory practise from which their patients secure no permanent benefit. For this the patients may be quite as much at fault as the doctor. Thorough diagnosis with its tests for blood, urine and sputum, its bacteriological examinations and perhaps its X-ray pictures and other procedures is coming to be beyond the resources of any one physician however well qualified. And all these things are expensive. Adequate medical aid is simply out of the reach of people in ordinary financial circumstances, and the experiences with doctors which they can afford are so frequently unsatisfactory that they lead to discouragement and cause many to put up with ills that are the source of much unhappiness. Humanity comes very far short of getting out of the medical profession the aid which it is capable of furnishing and which it could probably furnish without any greater expenditure of time and effort than now goes into the hurried examination of multitudes of patients and the scribbling of prescriptions for the relief of their symptoms. Just how the business of relieving the ills of the body should be organized I do not presume to state, but until it is done more effectively than it is at the present time the relations of the medical profession to the public will be subjected to more or less strain. This strain is increasing, and it may be productive of much harm in a number of ways. It will not be removed, I fancy, until some system is evolved whereby the rank and file of suffering human-

ity who have no relish for becoming charity patients can obtain the medical attention they require at prices that are not prohibitive. There is a growing sentiment, both in the medical profession and out of it, in favor of working out a solution of this problem, and we are perhaps justified in looking forward to a more effective and satisfactory regime in the years to come.

S. J. Holmes
University of California

THE RELATION OF THE TECHNICAL SCHOOL TO INDUSTRIAL RESEARCH[1]

Research is earnest, purposeful, persistent, intelligently directed effort to gain new knowledge of a selected subject. The spirit of research is devotion to truth and insistent longing for better understanding.

Industrial research is research done for industry. It may be:

1. In fundamental sciences, or
2. In applications of sciences.

It is difficult to set limits for the second class, distinguishing research from experimental development of processes, methods or equipment.

In the main, the environment of an industrial establishment is not congenial to fundamental research in the sciences. Furthermore, the connection between fundamental research and the business of a given establishment commonly is so attenuated that it is difficult for boards of directors to see justification for expenditure of stockholders' money for such research. Fundamental research, having less immediate connection with commercial profits, there is much less incentive for its control or for secrecy with respect to its results, in the interest of one establishment or group. Hence, fundamental research is especially suitable for those technical schools which can afford research departments. Then, too, such research lies close to the recorded knowledge and the theory with which the student has been familiarizing himself in his courses of study. It is a rare undergraduate, however, who will be competent for more than an assistant's part in research.

Industrial research in technology, or applied science, demands practical experience in the industry as a preparation for successful work. Indeed, it can not be done without knowledge of the particular industry. It often requires equipment or facilities of a kind or magnitude which can not be provided in technical schools. Only for limited problems, or under special arrangements, therefore, will this class of research properly be undertaken within a school. Students and faculty members may, however, participate in such research within an industrial plant under suitable conditions. Such direct connections with industry are stimulating to both teachers and students, and help to create a spirit of mutual appreciation between industries and schools.

The fields of research in which industry is concerned must not be too narrowly conceived by the schools. These fields are not limited to physics and chemistry, but include all the mathematical, physical and biological sciences, economics, and, not least, though mentioned last, those branches of inquiry which relate to men and women in industry, comprised in the term "personnel." To advance such studies, there has been established by the joint efforts of National Research Council and Engineering Foundation, the Personnel Research Federation. It has for its purpose the correlation of research activities pertaining to personnel in industry, commerce, education and government wherever researches are conducted in the spirit and with the methods of science. Its membership includes selected national organizations representing scientists, engineers, educators and the American Federation of Labor. The membership is now being widened to include other organizations of kindred interest. It has been learned that there are approximately 250 organizations in the United States giving

[1] A paper presented to the Conference on Engineering and Industry in connection with the inauguration of President John Martin Thomas, Pennsylvania State College, October 13, 1921.

some attention to personnel research along various lines.

It is surprising to one who has not had a share in the direction of a great engineering enterprise to learn how broad and various is the knowledge demanded in the creation of a Catskill aqueduct, a Panama Canal, a Pennsylvania Railroad system, a Niagara power development, an East River bridge, a Hudson tunnel, a manufacturing plant of modern magnitude, or a great mine.

A primary duty of technical schools is to discover young men with genuine research spirit and capacity. For this purpose, psychologists may be able to devise tests equivalent to those developed by Professor Seashore for detecting innate musical talent.

A second obligation is to train these naturally endowed men thoroughly for research careers. The technical schools should distinguish the individual who by nature is a lone worker from the team worker, and train each suitably, but should indicate to all the value of cooperation.

A third obligation is to instill the research spirit into all technical students. The technical school should foster the habit of inquiry—not mere inquisitiveness, but the purposeful search for truth, the alertness that asks "Why" of every phenomenon, the keenness of observation that does not pass indications which the dull-minded would call trivial.

The technical schools should not only discover and educate the rare man with research capacity, but should also train men who can be foremen and technical directors of industrial plants, capable of appreciating research and of working sympathetically with research specialists.

There are numerous ways in which each technical school can give research service to the industries within the region contributory to the school. Each school may well specialize to some degree according to the needs of its community. Through some central organization, the schools of the country should, however, keep one another informed of contemplated projects and specialities chosen so as to get the most beneficial distribution of such specialization without undesirable duplication. Choice of specialities should vary from time to time with progress in scientific research and change in the needs of industry.

In helpful relationship to research in the industries, the technical schools should teach their students:

1. How to assemble, arrange and analyze conditions so as to state a problem;
2. That it is wise before plunging into a program of work to learn what the literature contains (a large proportion of supposedly original problems can be answered from records of work done, to be found in our libraries);
3. The economy of spending sufficient time to understand the problem and to compare several methods before launching upon any one method of attack;
4. How to select and use the simplest apparatus and method for a given research which will accomplish the purpose, but to make sure of their adequacy; also how to analyze the apparatus and instruments, as well as the method, to detect unsuspected sources of error;
5. To limit the undertaking according to the resources and time available;
6. That there are elements of research in every technical task, which require the ever watchfulness for new light, new aspects, new applications;
7. How to extract research information out of both the ordinary experiences and the unusual happenings in the plant;
8. How to secure the intelligent and enthusiastic cooperation of foremen and operatives in observing closely and reporting accurately in the course of their daily work incidents which may be helpful to a research in progress;
9. The value of research, even when its results seem remote from the present purpose of industry;
10. How to express scientific knowledge interestingly—fascinatingly, but still correctly—in language readily understand-

able, by directors, managers and other executives;

11. To cultivate some of the journalist's sense of the story in research work;
12. And throughout their courses, the technical schools should teach the fundamentals of the sciences so thoroughly that the graduate can think for himself and will not be at his wits' ends when a problem in his future work does not fall within the limits of the formulae specifically taught or the books available.

Research has no end. It must be kept up perpetually. The technical schools must be soundly convinced of this fact and through their graduates, must impart it to the industries, lest unprogressiveness rob the community of the benefit of new knowledge.

Technical schools should convey, also, to their research students some conception of the exigencies and financial necessities of business and instill into them appreciation of the importance and difficulty of the financial problems and patience for the apparent slowness with which industry and business sometimes put into effect the results of research. The scientific man seeks the confidence and appreciation of the business man and he should reciprocate.

The greatest service of all which the technical schools and the universities can do for industry and for the community is to infuse into all workers from unskilled labor to highest executives that appreciation for truth and that conviction of the futility of deceit which are forced upon the scientist and the technologist, by the very nature of their work. Neither science, nor technology, nor industry, nor business, can permanently flourish on deception or on a narrow and selfish conception of profit.

Alfred D. Flinn

THE PRESENT STATUS OF UNIVERSITY MEN IN RUSSIA

For a long time after coming into power the soviet government of Russia maintained a seriously discouraging attitude toward the university faculties and the Russian professional and scientific men in general—the "intelligentsia." But this attitude is now modified and still modifying. Along with the other changes in attitude and action characteristic of the recent months of soviet government, changes very marked in relation to business and general economic matters, changes have also been made in the way of ameliorating the situation of the university men.

The salaries, paid in paper roubles of constantly depreciating value—they are now worth about 75,000 to the dollar!—were very low, becoming, indeed, as the value of the rouble lowered, simply derisory. But more important, in Russia, than any salary paid in money—unless it get into millions of roubles a month—is the "paiok" (I spell it as pronounced), or food ration, that is the essential part of the reward for services to the government. As is familiarly known, the soviet government established several grades of ration according to various categories into which the people could be roughly divided. The working man got the largest or best ration; the university man nearly the lowest.

In my recent (September-October) visit to Russia as special representative of the American Relief Administration, I learned something at first hand of the changing situation of the university and professional men of the country. I was not in Petrograd, but saw a number of faculty men in the universities of Moscow, Kazan, and Samara. Samara is one of the several new universities (?) set up by the soviet government. It has four faculties, medicine, law, agriculture and "workers." The "workers' faculty" offers elementary classes for the sons and daughters of working men and peasants to fit them for matriculation in the professional departments of the university. The president of Samara University, himself a specialist, as he said, in the Italian Renaissance, intimated that his institution was meeting many difficulties, the principal one being that of finance—a difficulty not unknown outside of soviet Russia. However, while we talked, students were

going in and out of his office apparently on the usual errands connected with registration, etc.

The University of Moscow expected to open in September but did not, and had not yet opened when I left Moscow early in October. I learned that the salaries and food ration of the Moscow men had been notably increased but did not learn details as I did at Kazan.

The salaries and "paiok" of the professors in the University of Kazan had been so meagre that not a man was able to live on them, and every professor was meeting his family's need for food by doing something besides regular university work. The means for keeping himself and family alive were various, but in almost all cases they included the successive sacrificing of personal and household belongings. One professor of biology told me that he made shoes, and that his wife baked little cakes and sold them in the city market. He had sold all of his own and his wife's simple jewels and trinkets and one of his two microscopes. Yet this man, who has not been able to see any books or papers published later than 1914, has struggled along with his special researches and has actually achieved two pieces of experimental work on vitamines which seem to me, with my little knowledge of the subject, to contribute certain definite new knowledge concerning these interesting substances.

But, beginning in August, there had been a material increase in salary and in food ration. The monthly food ration had been put, in August, on the following basis: dark (mostly rye) flour, 30 lb.; dried peas, 5 lb.; cereal grits, 15 lb.; sweets (not cane or beet sugar), 2 1/2 lbs.; tobacco, 3/4 lb.; butter, 6 lbs.; meat, 15 lbs.; fish, 5 lbs.; tea 1/4 lb.; white flour, 5 lbs. The items from dark flour to tobacco, inclusive, had been received; the rest of them, promised but not received. About 250 professors and instructors receive this ration. The university buildings are so cold that some of the men do all their work, except lecturing, in their homes. About 5,000 students had registered, but only about 10 per cent. of them were in actual attendance. The largest departments in point of student enrollment were medicine and science. My friend, the professor of biology, had never before ridden in an automobile until he rode with me in our relief car. About 20 men of the Kazan faculty have died in the last two years.

VERNON KELLOGG

NATIONAL RESEARCH COUNCIL

SCIENTIFIC EVENTS

GRANTS FOR RESEARCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE Committee on Grants of the association will hold its annual meeting during Christmas week, 1921, and will probably have at its disposal about four thousand dollars for grants in support of investigation in the different sciences. The committee especially invites suggestions from scientific men as to suitable places for small grants. Suggestions or applications should be sent before December 15 to the member of the committee in whose field the work lies, or to the secretary. The present personnel of the committee is Robert M. Yerkes, chairman; Henry Crew, C. J. Herrick, A. B. Lamb, George T. Moore, G. H. Parker, Joel Stebbins, David White.

JOEL STEBBINS,
Secretary of the Committee on Grants

URBANA, ILLINOIS

MAP OF THE NORTH PACIFIC OCEAN

A NEW base map of the North Pacific Ocean on the transverse polyconic projection has been prepared by W. E. Johnson, cartographer, of the U. S. Coast and Geodetic Survey of the Department of Commerce, and is now available for distribution. It is published in clear form and convenient size (dimensions 14 by 41 inches) for desk use.

This map is designed primarily as a base on which statistical data of various special kinds may be shown. In consequence of this purpose only features of major importance are shown on it and these features are emphasized to an extent not possible on a map which

contains the vast amount of detail usually included.

In addition to the foregoing specific value this map is of general interest at present as showing the relation between the United States, its possessions, and the Far East and as including those areas around which present problems in the North Pacific Ocean are centered. It extends from New York and Panama to Singapore and Calcutta, from Alaska and Siberia to the Hawaiian Islands and includes a part of South America and a portion of Australia. Through its lateral center it extends over 180°.

The distinctive feature of the map is that these localities are here pictured in practically their true relation as to distances, areas, and comparative angular direction of coast line. The property of true scale along a great circle tangent to the forty-fifty parallel of north latitude at the central meridian of the map was chosen. This great circle is approximately the shortest distance between San Francisco and Manila, and in close proximity to it lie practically all the important points of interest such as the Panama Canal, Mexico, our Pacific Coast, Alaska, the Philippine Islands, Japan, and the coast of China. This is accomplished through the use of the transverse polyconic projection, which is the regular polyconic or American projection turned from its normal vertical axis to a lateral great circle axis.

THE STEAMER "ALBATROSS"

The Fisheries Service reports that the steamer *Albatross* has been taken to Woods Hole (Mass.) and on October 29 was there put out of commission, the naval crew being released. This action was made necessary by a lack of sufficient funds to operate the vessel on a scale that would yield results commensurate with the basic cost of maintenance. It is hoped that by another year it may be possible to restore the vessel to active service and assign her to work on fishing grounds on the Atlantic coast awaiting attention.

The *Albatross,* which for nearly forty years has been an important unit of the Bureau of Fisheries, was the first vessel especially designed for deep-sea exploration and was equipped with the most approved apparatus and appliances for the work. These have been renewed, modified, or extended as the occasion arose. The vessel was built under the supervision of Commander Z. L. Tanner. United States Navy, from designs prepared by the naval architect, Charles W. Copeland. She was launched at Wilmington, Del., in 1882, and, excepting brief interruptions, has been constantly employed until the present time. The fact that after all these years she is now in excellent condition is a tribute to her construction, the quality of the material used, and the care which she has had.

The *Albatross* was engaged in investigations off the Atlantic coast from Newfoundland to the West Indies until 1888, when she was sent through the Straits of Magellan to the west coast, and during the next 30 years was engaged in investigations, surveys, etc., in the Pacific Ocean, particularly in Alaska. During the long period of the fur-seal controversy the *Albatross* formed part of the naval patrol of Bering Sea and was used by the commission created for the investigation of the fur seals. In 1891 the vessel was employed in surveying a cable route to the Hawaiian Islands, in 1899 and 1900 in a voyage to the tropical Pacific and Japan, in 1902 in investigations about the Hawaiian Islands, and from 1907 to 1910 in a comprehensive survey of the fisheries and aquatic resources of the Philippine Islands. In the War with Spain and in the World War the *Albatross* was taken into the naval service, returning to the Atlantic coast in 1917.

MULFORD EXPLORATION IN BOLIVIA

The latest message received from Dr. Rusby, the director of the Mulford Exploration, was dated August 30 and was written from Huachi on the Bopi River in Bolivia. Dr. Rusby arrived at Huachi on August 23 and he and his party spent some time making collections in the vicinity and making excursions into surrounding territory. During their stay there four members of the party made a trip up the Cochabamba River.

Dr. Rusby states that the journey from Espia, at the head of navigation on the Bopi River, down to Huachi, was accomplished successfully except for the loss of five boxes of provisions and ammunition. The loss of their ammunition leaves the party in a rather precarious condition as they were depending on it for obtaining not only museum specimens of rare birds and small mammals but also to supply the camp with fresh meat.

Among botanical collections are included specimens of the "tree of life." This name is a literal translation of the Spanish name "Arbol de la Vida," given to the "Boldo" plant, so called because of its use by the natives for medicinal purposes. Photographs were made of what Dr. Rusby considers the largest true cactus in the world, which rises to the height of a good-sized tree and with a limb spread of forty feet or more.

Many forms of insect life have been collected. With these, as in the case of plant life, specimens collected in one of these deep Andean valleys may differ entirely from those of a similar valley very closely adjacent.

The party expected to arrive at Rurrenabaque, Bolivia, about October 1 and by this time are probably forcing their way into the depths of the Bolivian jungle in the vicinity of Lake Rocagua.

THE ECLIPSE EXPEDITIONS TO CHRISTMAS ISLAND

ACCORDING to an article in the London *Times*, with the aid of the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society, the Royal Observatory at Greenwich is sending an expedition to Christmas Island to observe the total eclipse of the sun which will occur on September 21 next year.

The Greenwich party will consist of Mr. H. Spenser Jones, Chief assistant, and Mr. P. J. Melotte, the discoverer of the eighth satellite of Jupiter. They will leave England early in February for Singapore, whence they and their equipment will be conveyed to the island by a steamer belonging to the Christmas Island Phosphate Company, which is giving valuable help to the project.

A joint Dutch and German expedition, the personnel of which will include Professor Voute of Batavia University and Professor Freundlich of Germany, will also go to Christmas Island, and it is possible that Professor Einstein will himself be present to observe the eclipse.

It is hoped to confirm the results obtained by the British expeditions at Principé and Sobral during the eclipse of May, 1919, when Einstein's prediction as to the value of the deflection of a ray of light passing through a gravitational field was verified by measurements of the position of start in the immediate neighborhood of the sun during totality.

It has been arranged that the Greenwich expedition, which will have erected its instruments by May, shall carry out an extensive program of photometric work. Based on the Harvard standard sequence of stars at the North Pole comparisons will be made of areas in South Declinations 30 deg. and 45 deg., with areas in North Declination 15 deg. Magnitudes of stars in the latter zone have already been determined at Greenwich in direct comparison with those in the North Polar area, and the photographs to be taken at Christmas Island will enable work on these lines in the northern and southern hemispheres to be linked up and carried on to the South Polar area by southern observatories. The equipment to be taken by the British party will include the 13 in. astrographic telescope used in the making of the Greenwich sections of the international photographic chart of the sky.

The path of totality will begin in Abyssinia, pass over the center of Italian Somaliland and across the Maldive Islands, where Mr. J. Evershed, the director of the Kodaikanal Observatory (India), will be stationed. At the Maldives the duration of totality will be 4 min. 10 sec. with the sun 34 deg. above the horizon. At Christmas Island the duration will be only 3 min. 42 sec., but the sun will be 78 deg. above the horizon. The maximum duration, nearly 6 min., occurs over the Indian Ocean where no observing station exists. After leaving Christmas Island the

path of totality crosses Australia in latitudes which, except in Queensland and in a corner of New South Wales, are to the north of the inhabited regions of the continent, and ends near Norfolk Island in the Pacific. It is possible that an Australian expedition will observe the eclipse from the neighborhood of Cunnamulla.

Christmas Island is an isolated island lying to the south of Java in Lat. S. 10° 25′, Long. E. 105° 42′. It is about 12 miles long and nine broad and rises to a height of over 1,100 ft. The population of the settlement, called Flying Fish Cove, after the warship which discovered the anchorage, is about 250, consisting of Europeans, Indians, Malays, and Chinese. The island is attached to the Straits Settlements administration and was annexed by the United Kingdom in 1888.

SCIENTIFIC NOTES AND NEWS

Charles R. Cross, professor emeritus of physics at the Massachusetts Institute of Technology, died on November 16 in Brookline aged seventy-three years.

Dr. W. J. Mayo delivered the John B. Murphy memorial address before the meeting of the Clinical Congress of the American College of Surgeons in Phildelphia at which meeting honorary fellowships in the Royal College of Surgeons of Ireland were conferred upon him and on Dr. C. H. Mayo.

C. O. Mailloux, chairman of the International Electrotechnical Commission, has been invited by the President of the French Republic to deliver on November 24, the address of eulogy on Ampère. The ceremony will take place at the Sorbonne in Paris.

The magnetic-survey yacht *Carnegie*, under the command of J. P. Ault, returned to Washington on Thursday, November 10, thus satisfactorily completing her two years' world cruise. Dr. Bauer, director of the Department of Terrestrial Magnetism, joined the vessel at Panama and remained with her until the arrival at Washington. Although considerable rough weather was encountered, it was found possible with the special appliances aboard the *Carnegie*, to make satisfactory magnetic and electric observations daily.

Eight medical investigators, five Americans and the other three British, sailed from New York on November 16 on the *Santa Teresa* for Peru, where they will undertake studies of the physiological changes which enable people to live permanently at high altitudes. The party will make their headquarters at Cerro de Pasco, Peru, situated in the Andes at a height of over fourteen thousand feet. The American members of the party are Dr. Alfred C. Redfield, assistant professor of physiology at the Harvard Medical School; Dr. Arlie V. Bock, M.D., of the Massachusetts General Hospital; Dr. Henry S. Forbes, now engaged in research in industrial medicine at Harvard; Dr. C. A. L. Binger, of the Rockefeller Institute, New York, and Dr. George Harrop, late of the Presbyterian Hospital, New York.

Sir Robert Wood, president of the Royal College of Surgeons of Ireland, Sir William Taylor, ex-president of the same organization, and Professor Shoemaker, of The Hague, visited the Mayo Clinic on November 1, 2, and 3. A meeting was held in their honor in the lobby on November 2, at which time Sir Robert Wood gave a brief talk on education in Ireland; Sir William Taylor discussed the organization of the Royal College of Surgeons of Ireland, and Professor Shoemaker spoke on operations on the stomach and colon which he had originated.

A delegation of Serbian physicians, guests of the Rockefeller Foundation, visited the Mayo Foundation on October 27 and 28. The delegation is composed of Dr. G. J. Nikolitch, under-secretary and first medical officer of the Ministry of Health of Serbia; Dr. G. Joannotitch, professor of pathologic anatomy, and Dr. R. Stankovie, professor of internal medicine, in the Belgrade Medical School. Mr. Frank B. Stubbs, of the Rockefeller Foundation, and Dr. Henry John, of Cleveland, accompanied the delegation.

Charles E. Weaver has resumed his professorship of geology in the University of Wash-

ington, after a three-years' leave of absence which he spent in Central and South America as geologist for the Standard Oil Co.

DR. WILLIAM CROCKER, director of research of The Thompson Institute for Plant Research, Yonkers, New York, sailed on the *Olympic* on October 15, for a three- or four-months' stay in Europe. He will visit England, France, Germany, Austria and other European countries for the purpose of acquiring materials for the library and of studying the organization, equipment and activities of the principal biological institutions of Europe.

PROFESSOR C. C. NUTTING, head of the department of zoology at the University of Iowa, who has conducted expeditions to the Bahama Islands and to Barbados and Antigua in the interests of scientific research work at the university, has been invited by Colonel Fell, secretary for the Fiji Islands, to bring an expedition there. Secretary Fell was formerly governor of the Barbados Islands, where he was stationed when the Iowa Expedition visited there in 1918.

M. Y. WILLIAMS, professor of paleontology in the University of British Columbia, Vancouver, is one of a party sent out by the Canadian Geological Survey to make a survey of the Mackenzie River district.

PROFESSOR N. I. VAVILOV, of the Petrograd Agricultural Institute, who can be addressed in care of W. P. Anderson, 512 Fifth Ave., New York, states that the first Russian Eugenics Society was founded in Petrograd and Moscow two years ago; and that the president of this society, Dr. N. K. Koltzon, requests American eugenicists to send their publications to the society through Professor Vavilov. Scientific literature has not reached Russia for the past four years.

PROFESSOR JACQUES CAVALIER, rector of Toulouse and a widely known authority on metallurgical chemistry, is in America as the result of arrangements for an annual exchange of professors of engineering and applied science between French and American universities. Professor Cavalier, who is now at Columbia, will divide his time during the academic year among the cooperating institutions, Columbia, Harvard, Yale, Cornell, Johns Hopkins, Massachusetts Institute of Technology and the University of Pennsylvania. The American universities have, as has been already noted here, selected as their representative for the first year Dr. A. E. Kennelly, professor of electrical engineering at Harvard and the Massachusetts Institute of Technology.

DR. HAWLEY O. TAYLOR, associate physicist at the Bureau of Standards, has resigned to take charge of the electrical department, Division of Rehabilitation, Franklin Union, Boston. Dr. Taylor was formerly radio engineer of the Signal Corps of the U. S. Army; research physicist of the National Electric Signaling Co., Brooklyn; and research associate at the Massachusetts Institute of Technology.

JOHN MILLS, for ten years a member of the Research Laboratories of the American Telephone and Telegraph Company and the Western Electric Company, has been appointed assistant personnel manager in charge of educational promotion in the engineering department of the Western Electric Company.

PROFESSOR R. C. ARCHIBALD, of Brown University, has been granted leave of absence for the second half of the academic year. He expects to spend it in visiting mathematicians at universities of Italy, France, Belgium, Holland, Scandinavia and Great Britain.

DR. C. C. LITTLE, research associate, of the Station for Experimental Evolution of the Carnegie Institution of Washington, will deliver the second Harvey Society Lecture at the New York Academy of Medicine Saturday evening, November 26. His subject will be "The relation of genetics to cancer research."

PROFESSOR F. E. ARMSTRONG, professor of Mining at Sheffield University, has died at the age of forty-two years.

THE death is reported from Paris, at the age of seventy-two years, of the French engineer, M. Albert Sarpiaux, who had long been connected with the scheme for the construction of a tunnel under the French Channel.

UNIVERSITY AND EDUCATIONAL NEWS

The General Education Board and the Carnegie Corporation have jointly promised $100,000 to the Medical College of the University of Georgia, to be paid at the rate of $20,000 a year for the next five years on condition that a like amount each year is raised from other sources.

Professor C. J. Tilden, who has been director of the highway and highway transport education committee, in Washington, D. C., since December, 1920, has returned to Yale University to resume his work as professor of engineering mechanics.

Dr. Frederick H. Falls, of Chicago, has been appointed head of the department of gynecology and obstetrics of the State University of the Iowa College of Medicine.

Dr. T. L. Patterson, formerly of the physiologic department of the State University of Iowa, has been appointed professor and director of the department of physiology at the Detroit College of Medicine and Surgery.

D. Walter Munn has resigned his position of professor of engineering and head of the engineering department at the Royal Military College to become professor of mechanical engineering at the Nova Scotia Technical College, Halifax, N. S.

DISCUSSION AND CORRESPONDENCE

POSITIVE RAY ANALYSIS OF ZINC

With the apparatus previously used in the analysis of lithium and magnesium,[1] which will be described fully in the *Physical Review* for December, I find that the element zinc is a mixture of four isotopes, separated by two units in atomic weight. Although slight variations were observed in the relative intensities of the components, they are approximately given by the ratios 6 : 7 : 10 : 1, the heaviest being much weaker than the three lightest. The measurements in themselves do not give the values of the atomic weights with an accuracy of one unit, but since the separation in each case is exactly two units, and all other elements hitherto analyzed have integral atomic weights, with oxygen = 16 as a basis; we may assume that the zinc components are also integral. In this case the only values possible are the atomic weights 63, 65, 67, and 69, since these values with the above intensity ratios give a mean atomic weight of 65.5 and a displacement of the group one unit either way would make the mean differ by a whole integer from the accurately determined chemical atomic weight 65.4.

A. J. Dempster

Ryerson Physical Laboratory,
University of Chicago

1 Science, December 10, 1920; April 15, 1921.

THE REDISCOVERY AND VALIDITY OF ARCA LITHODOMUS SOWERBY

Nearly a century ago, in 1827–1830, Mr. H. Cuming made an extensive voyage along the western coast of South America collecting natural history specimens. The shells obtained by Cuming were described by Broderip and Sowerby. Among the Noah's Ark shells was a most curious species, named by Sowerby *Byssoarca lithodomus*[1] and figured by Reeve.[2] The shell was cuneiform, very finely ribbed, and covered with beautifully imbricated scales. It measured 3.5 inches in length and 1 in height. It was found by Cuming at Monte Cristi, Ecuador, about Lat. 1° South.

In 1840, Gray established for this singular *Arca* the section *Litharca,* which, in 1887, Fisher recognized as a section of the subgenus *Barbatia.* Dr. Dall, in 1898[3] thought the species invalid, and that the type was probably a shell of *Arca candida* that had grown in a *Lithodomus* burrow. But in his Peruvian catalogue, 1910, he listed the species, referring it back to Cuming's shell and placing it in the subgenus *Barbatia.*

Mr. Axel Olsson, while at Bucaru, Los Santos Province, on the western boundary of Panama Bay, in 1921, was so fortunate as to find a single valve which is the sole ex-

1 *Proc. Zool. Soc. London,* p. 16, 1833.

2 Conch. Icon., *Arca,* pl. 12, f. 76, 1844.

3 *Trans. Wagner Inst. Sci.,* 3, pt. 4, p. 615.

ample ever found since Cuming collected his shell on the coast of Ecuador. Mr. Olsson's specimen is younger and smaller than the type, but is undoubtedly a valve of this very striking and rare species.

An examination of this shell proves that *Arca lithodomus* is not an *Arca (Barbatia) candida* of abnormal type, for it is clearly an undistorted specimen. Moreover, it is not a member of the subgenus *Barbatia.* Dr. Pearl Sheldon, the *Arca* expert, pronounces it a true Ark. Therefore, the rediscovery by Mr. Olsson, in Panama, of Cuming's Ecuadorean shell proves (1) that *Arca lithodomus* Sowerby is a valid species; (2) that the shell belongs to *Arca, sensu stricto;* (3) that the section *Litharca* Gray is unnecessary; (4) the range of the species is extended from about Lat. 1° South to approximately Lat. 7° 30′ North.

CARLOTTA J. MAURY

CORNELL UNIVERSITY

THE GEOGRAPHICAL DISTRIBUTION OF HYBRIDS

IN a former number of this journal, Professor Fernald has done me the honor of stating that he is glad to have my confirmation of his "thesis" in regard to the geographical distribution of hybrids between natural species. As my statement was merely a brief summary of the views of the eminent Austrian systematic botanist, Kerner von Marilaun, Professor Fernald does me undeserved honor, and at the same time is unfortunately guilty of an anachronism. Kerner's views on hybrids were known to the world some time before Professor Fernald's star arose on the horizon.

I think I made it clear in my former statement, that according to Kerner, natural hybrids may occur not only within the range of the parent species, but *also beyond the range of one or both of them.* The situation indicated by the words in italics is clearly not in accord with the tenor of Professor Fernald's biting criticisms of the recent work of Brainerd Peitersen on the blackberries of New England. He repeatedly condemns these authors for entertaining the heterodox idea that a hybrid can occur beyond the geographic range of one of its parent species. In this attitude my colleague is obviously not in harmony with Kerner. It may be emphasized that Kerner's views possess a peculiar authority, not only because he devoted himself especially to the study of hybrids in nature, but also because he was fortunate enough to live in a region where the Pontic, Mediterranean, and Baltic floras overlap.

I am loath to attribute to my colleague the intentionally ambiguous language of an oracle, or the "weasel words" of the aspiring politician. His statements, however, appear to keep the word of promise to the ear, while breaking it to the hope, as in that Shakespearian tragedy where a forest undergoes an interesting geographic migration, not due to the mineral characteristics of the substratum.

E. C. JEFFREY

THE RAY SOCIETY

ALL interested in natural history are familiar with the publications of the Ray Society. Since its establishment over three quarters of a century ago this society has published annually one or more volumes in the biological sciences. Its object is to issue works which from the expense of illustration or other causes could not profitably be brought out by an ordinary publisher. In this way have appeared Agassiz's four volumes of Bibliography, Darwin's "Cirripedia," Allman's "Tubularian Hydroids" and "Freshwater Polyzoa," Alder and Hancock's "Nudibranches," West's "Desmids," Cash and Wailes's "Rhizopods and Heliozoa," Groves and Bullock-Webster's "Charophyta," and Lucas's "Orthoptera."

The annual subscription to the society is at present one guinea, in return for which the subscriber receives the annual volumes and has the privilege of purchasing, at a reduction from the published price, one copy each of any of the society's works already issued and remaining in stock. Subscribers for 1921 will receive for that year one of the

parts of the beautifully illustrated monograph on British Annelids by Professor W. C. McIntosh, a work that will probably be priced to the public at over two guineas.

The income of the society is derived almost entirely from its list of subscribers and it is imperative, if the society is to continue its activities, that this list be enlarged. It is, therefore, hoped that American naturalists will show their appreciation of the good work of the Ray Society by giving it their hearty support. The annual subscription of one guinea should be sent to the secretary of the society, Dr. W. T. Calman, 1 Mount Park Crescent, Ealing, London, W. 5, England.

G. H. PARKER

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SCIENTIFIC BOOKS

The Analysis of Mind. By BERTRAND RUSSELL, F.R.S. New York: The Macmillian Company. Pp. 310. 1921.

It would not be difficult to show that in the course of the centuries mathematical developments were much retarded, sometimes arrested or diverted from their natural course, by an unenlightened psychology and especially by a crude psychology of mathematics. The fact is evident both in the history of algebra and in that of geometry. Not only was the development of the number concept hampered, but the advent of the concepts of hyperspace and non-Euclidean geometry was delayed for two thousand years, by a psychology that in things mathematical often did not know a knee from an elbow. It is, therefore, a special pleasure to note and to welcome the appearance of a psychological work by an eminent contributor to the literature of mathematical foundations. Compared with the work which has been done in the logic of mathematics, that which has been done in the psychology of the subject is exceedingly meager, and the explanation is obvious: mathematicians have been psychologically incompetent, and psychologists mathematically incompetent, to deal with the matter. The work in hand is indeed not specifically concerned with the psychology of mathematics; its scope is general; but it is likely to awaken psychological interest among mathematicians and may incite some of them to study the psychological aspects of their own science.

This volume consists of a course of lectures given in London and Peking. Its motive is a primarily logical one for the work has sprung out of the seeming discordance of two present scientific tendencies, one of them in psychology, the other in physics; the former may be called a tendency to materialize mind; the latter, a tendency to "spiritualize" matter; they are both of them methodological rather than metaphysical. The former tendency, most notably represented by the behaviorist school of psychologists (like Professor Watson, for example), is manifest in the distrust of introspections as a means to knowledge of mental phenomena and in the growing dependence of psychology upon external observation of animal and human behavior and upon physiological experiment, as if matter were regarded "as something much more solid and indubitable than mind." The other tendency, most notably represented by workers (like Professor Einstein, for example) in physical theories of relativity, is manifest in the increasing inclination of physicists to regard "events" as primary and to derive "matter" from them, or to make it out of them, by the processes of logical construction.

If we regard both of these counter tendencies as being in the main sound, as Mr. Russell regards them, they confront us with a certain logical problem which every one must feel the challenge of and which Russell, owing to a highly refined logical sensibility, feels with especial keenness. The problem is that of reconciling the two tendencies, seemingly so inconsistent; it is the problem of determining their joint significance; the two tendencies face each other, move towards each other, and, pointing in opposite directions, seem to indicate a common goal—some important truth lying, so to speak, between them, and the problem is to ascertain that truth, if such there be.

The problem is not men. From the psychological side it was assailed by William James especially in his later years and since then it has been attacked from the philosophical and logical side by the American school of so-called new realists, Professor R. B. Perry, Mr. E. B. Holt, and others. With what results? By James, consciousness regarded as an entity, was rejected outright. According to his view, the world is not fundamentally composed of two different things, mind and matter; it consists of one "primal stuff," which he called, somewhat unhappily, "pure experience"; between portions of the primal stuff there are various sorts of relations, which are parts of the stuff and of which the portions are the terms; one kind of the relations is called "knowing"; such a relation has two terms, one of which is called the "knower" and the other the "known." In James's view, that is the common goal of the two tendencies I have mentioned; that is the truth that is being approached by psychology from the one side and by physics from the other. And the finding of the new realists is much the same. Rejecting the unfortunate term "pure experience," they maintain that what is called mind and what is called matter are both of them composed of a "neutral-stuff" which is in itself neither mental nor material, neither mind nor matter.

Russell deals with the problem in the light of the foregoing views but he handles it afresh, in a way that is quite his own, bringing to the task a native and acquired equipment—logical, mathematical, philosophical—that gives his work surpassing importance. What is his main conclusion and how is it related to that of James and his American disciples? Russell, like James, rejects consciousness regarded as an entity; neither is consciousness an essential quality or a simple companion of mental phenomena. "Consciousness" he finds to be "a complex and far from universal characteristic of mental phenomena." In holding that "sensations are what is common to the mental and physical worlds," that sensations are literally "the intersection of mind and matter," he agrees with the American realists and with Ernst Mach;[1] and so, with respect to *sensations*, he agrees with the realists in the thesis that the world is composed of a "neutral-stuff"; but he does not agree with them in his maintaining that *images* are not reducible to sensations and in his conclusion that "images belong only to the mental world." The final conclusion is:

> All our data, both in physics and psychology, are subject to psychological causal laws; but physical causal laws, strictly speaking, can only be stated in terms of matter, which is both inferred and constructed, never a datum. In this respect psychology is nearer to what actually exists.

How are the results arrived at? The answer can not be given in a brief review, and the reader must be referred both to this volume and to its companion "Our Knowledge of the External World" published a few years ago. The earlier work, which deals with the physical aspects of the same problem, is chiefly concerned with the question whether, how, and to what extent the so-called constituents of matter are constructible out of sense-data by logical processes. The two works are thus complemental, together constituting a whole.

Suffice it to say that, so far as the present volume is concerned, the results are reached by a diabolically ingenious analysis of such things as instinct and habit, desire and feeling, psychological and physical causal laws, introspection, perception, sensations and images, memory, words and meaning, general ideas and thoughts, belief, truth and falsehood, emotions and will; and by an equally ingenious synthesis, or logical construction, making many familiar things seem strange—desire, for example, appearing as a mere "fiction" like force in dynamics—and showing many seemingly simple and primitive things to be complex and derivative. It is noteworthy that the least original and weakest part of the analysis is that of the emotions and will, commonly regarded as mental

[1] "Analysis of Sensations, 1886."

phenomena *par excellence,* while curiosity or wonder, which Aristotle regarded as the very beginning of knowledge, is not discussed at all in terms.

It seems a bit strange that the book does not mention the recently published works ("The Principles of Natural Knowledge," and "The Concept of Nature") of Professor Whitehead, for these works are weighty contributions to the problem Mr. Russell is trying to solve.

I wish finally to say that as a model exhibition of the scientific spirit, this work would be highly valuable even if its conclusions were unsound. Mr. Russell's notably frequent public recantations of opinion, of which there are no fewer than five instances in the present work, are regarded by some as a token that he does not know his own mind or that he publishes prematurely. Such critics are no doubt mistaken. The frequency of recantation in Mr. Russell's writings is due partly to the exceeding difficulty of the fields in which his researches lie, partly to his ceaseless re-examination of seeming certitudes, and partly to an unsurpassed intellectual candor.

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TESTIMONIAL TO DEAN H. L. RUSSELL

(*From a correspondent*)

At the October meeting of the Wisconsin branch of the Society of American Bacteriologists, Dean H. L. Russell was presented by his former students with a volume entitled "Papers on Bacteriology and Allied Subjects." This memorial was given in commemoration of the twenty-fifth anniversary of his doctorate. The real anniversary day occurred several years ago but due to the war conditions immediately following, the publication of the volume was delayed.

It is a comprehensive volume containing contributions from thirteen of the leading bacteriologists who were among the early students of Dr. Russell. E. G. Hastings, of the University of Wisconsin, reviews the dean's scientific career and points out the strategic opportunities presented to pioneer bacteriologists. Dr. Russell was the first full-time agricultural bacteriologist in America. He was likewise one of the first men to be employed in this country to teach and do research work in bacteriology outside of the medical school. His scientific papers, books, and bulletins number well over 125 and are of fundamental importance.

A development of the city milk supply problems is the contribution of H. A. Harding, formerly of the University of Illinois. He states the problems past and present in an interesting way and concludes by saying of Dr. Russell,

> This pioneer bacteriologist in person and through his students has taken an honorable part in the solution of these problems.

That the greater prevalence of mold spores over bacteria in the air is due to the fact that most bacteria are readily killed by the sun's rays while mold spores are only slightly affected is the conclusion reached by John Weinzirl of Washington State University in his treatise on the resistance of mold spores to sunlight.

In a series of experiments carried on at the University of Minnesota, C. H. Eckles found that the percentage of fat in milk could be markedly increased for the first twenty to thirty days when it is followed by underfeeding during the period of lactation. Underfeeding of the cow must be taken into consideration in the interpretation of data involving variation in the composition of milk and butter fat.

L. A. Rogers, chief of the dairy division of the United States Department of Agriculture, summarizes the work done in his department on the characteristics of the *colon-aerogenes* group of bacteria. He regards *B. coli* and *B. aerogenes* as very distinct types. He discusses the taxonomic position of other members of this group in relation to these two varieties.

D. J. Davis, of the medical school of the University of Illinois, presents evidence and argues convincingly to show that the fungus which causes sporotrichosis disease affecting

both man and horses and common in France and occasionally in America, is identically the same species and should be called by the name first used by Hektoen in this country.

A butter having only a few yeasts and molds, when other conditions are favorable is a safer hazard for shipments and storage is the claim of F. W. Bouska and J. C. Brown of Chicago in their paper on "Yeasts and oidia in pasteurized butter." Creameries which have the best commercial reputation for their butter also have the lowest yeast and mold counts. These two men give methods for sampling and counting butter which they have recently devised.

The late Dr. Edw. Birge presented his study on the activities of certain bacteria in sewage. He believed that some bacterial forms can be found which will play an important rôle in the treatment of sewage, and that the time will come when septic tanks will be seeded as alfalfa fields and cream vats are seeded now.

A method for the detection of pasteurized milks is described in detail by Dr. W. D. Frost, of the University of Wisconsin. The addition of a special dye stains the blood cells, always present in pasteurized milks. In raw milks the cells will not be stained.

A strong plea for the thorough investigation of all waters whose potability is questioned, and for thoroughly trained investigators experienced in laboratory and field work, is put forth by H. A. Whittaker, of the University of Minnesota, in a paper on the "Investigation of drinking water supplies."

A. L. Amott, a commercial milk expert in Chicago, has given much time, energy and thought to "The milk supply of Chicago," and discusses the source of supply, amount, production, transportation, city distribution, prices, farmers' organizations, and milk inspection. He calls attention to the improvement of the milk supply and the lowered baby death rate in recent years in Chicago.

B. W. Hammer, of the Iowa Agricultural College, in a paper on "The bacteriology of ice cream," summarizes the knowledge of such points as number and kinds of bacteria, sources of materials, effect on the bacteria during freezing, hardening and holding, softening and rehardening. He also treats of the manufacture of ice cream with a low bacterial count, and the relation of ice cream to the public health, and bacterial standards.

SPECIAL ARTICLES

THE QUANTITATIVE BASIS OF THE POLAR CHARACTER OF REGENERATION IN BRYOPHYLLUM

When the defoliated stem of a plant of *Bryophyllum calycinum* is cut into as many pieces as it possesses nodes, each piece will produce shoots from the two dormant buds of its node and roots at its basal end. When a long piece of stem possessing 6 or more nodes is cut out from such a plant only the most apical node will produce shoots from its two buds while the other nodes will show no or only inconsiderable growth. The question is, Why do all the nodes except the most apical fail to produce shoots when they are part of a long piece of stem, while they would each produce shoots when isolated? This is the problem of polarity in regeneration in its simplest form.

Earlier biologists, especially Sachs, have suggested that this polarity is due to the fact that the ascending sap carries the substances needed for shoot regeneration and that if a piece of stem is cut out from a plant the sap must collect at the apex and thus give rise to the shoots at the most apical node. This explanation is only satisfactory if the assumption is added that in the case of the stem of *Bryophyllum* practically none of these substances reach the dormant buds in the nodes below the most apical one. The problem is how to furnish a scientific proof for this suggestion. This can be done by treating this problem from the viewpoint of chemical mass action.

The formation of new shoots in an isolated node of a defoliated stem of *Bryophyllum* can only be the result of synthetical processes the velocity of which depends for a given temperature and degree of moisture upon the relative mass of the material reaching the dormant buds of the node in the unit of time. The material required for growth will be taken from the sap reaching the node. The disappearance of this

material from the sap will cause similar material to leave the cells of the stem and to diffuse into the sap. If this purely chemical reasoning is sound it would follow that the larger the mass of the stem the greater the mass of chemical substances available for the growth of shoots per unit of time. On this basis we should expect that the mass of shoots formed on the node of an isolated piece of stem would be in proportion with the mass of the piece of stem. That this is correct can be shown by cutting a defoliated stem of *Bryophyllum* into as many pieces as it possesses nodes. In this case, each node will produce shoots but their mass will be unequal in the different pieces, and will be greatest where the mass of stem is greatest.

If it is true that in a long defoliated piece of stem only the two shoots of the apical node grow out because practically all the material available in the stem flows to the apex; and that the shoots in the nodes below do not grow out because practically none of the material reaches them, then we should expect that the mass of the two shoots formed at the apex of a long piece of stem should approximately equal the mass of all the shoots which would have been formed if the stem had been cut into as many pieces as it contained nodes. A large number of experiments have been made which have shown that this is correct. The following example may suffice: Four large stems of *Bryophyllum* were defoliated and a piece containing 9 nodes was cut from each defoliated stem. From each piece of stem the three uppermost nodes were cut off and cut into three pieces containing one node each. These 12 one-node pieces produced 23 shoots. The 4 stems, with 6 nodes each, produced all together 8 shoots. After 20 days the dry weight of the shoots and of stems was determined. It was found that the 12 small pieces of 1 node each had produced 23.2 mg. dry weight of shoots per gram of dry weight of stems, while the 4 large pieces with 6 nodes each had produced 26.3 mg. dry weight of shoots per gram of dry weight of stems.

This shows that the mass of the two shoots produced at the apex of a long piece of stem equals approximately the mass of shoots which would have been produced in the same stem in the same time under the same conditions if the shoots could have grown out in all the nodes. This leaves no doubt that the polar character of the regeneration of shoots is due to the fact that all the material available for growth reaches the apical and none of the other nodes of a long piece of stem. The average growth of shoots in small pieces is slightly less than in large pieces in the experiment mentioned (23.2 mg. instead of 26.3 mg.), probably because the extreme ends of each piece die or cease to participate in the supply of material for growth. As a consequence the mass of a stem which supplies material for growth is less when the stem is cut into smaller pieces than when it is left intact.

It had been shown in previous papers that the mass of shoots and roots produced by a leaf of *Bryophyllum* is also in proportion to the mass of the leaf.[1]

A fuller description of the results will be given in the *Journal of General Physiology*.

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THE SCATTERING OF ELECTRONS BY NICKEL

A study of the electron emission from a nickel target under electron bombardment has revealed certain features of this emission which appear to be of considerable interest on account of their probable bearing on the structure of the nickel atom.

Besides the emission of slow-moving secondary electrons characteristic of all metals the emission from nickel contains an appreciable fraction of electrons of higher speed which appear to be scattered directly from the incident beam of primaries by the atoms of the target. The fastest of these scattered electrons have speeds almost if not quite equal to the speed of the primaries. It would appear that the sharp deflections experienced by these scattered electrons must result from their penetrating into the atom structure and being

[1] Loeb, J., *J. Gen. Physiol.*, 1918–19, I., 81; 1919–20, II., 297, 651.

swung about by the strong field there encountered. For an electron to thus enter and emerge from an atom without appreciable loss of energy would seem to require that it do so without having a near encounter with any of the electrons of the atom structure. On the other hand the structural electrons may be so anchored in position that no energy is transferred to them in any except very close encounters. The fraction of the primary electrons scattered from a nickel target without appreciable loss of energy is small, not more than one in a thousand being turned back with a loss not to exceed one per cent. of its initial energy.

The distribution of these high-speed scattered electrons in the region in front of the target is particularly interesting. Our observations suggest that it is entirely symmetrical with respect to the incident beam and independent of the inclination of the target to the incident beam except as this affects the region into which the scattered electrons are free to emerge. With a target inclined at an angle of 45 degrees to the incident beam the intensity of scattering as a function of angle has been studied in the plane including the incident beam and the normal to the target. The range of 135 degrees on one side of the incident beam has been explored with the exception of 25 degrees adjacent to the beam. The Faraday box collector used for picking up the scattered electrons can not be brought nearer the primary beam in our present apparatus. The principal features of the angular distribution are two maxima of emission, one back along the path of the bombarding electrons ($\Psi = 0$) and another lateral to the primary beam whose position depends upon the bombarding voltage. The relative importance of these two maxima also depends upon the speed of the primaries.

Fig. 1 shows such a distribution curve for a bombarding potential of 150 volts. The intensity is measured as the ratio of the current entering the Faraday box collector to the total current reaching the target. The opening in the Faraday box subtends about .03 of unit solid angle to the spot under bombardment. The retarding potential between box and target for the curve, Fig. 1, is 135 volts, so that only electrons that have lost not more than 10 per cent. of their initial energy are caught. The effect of bringing the retarding voltage nearer the bombarding volt-

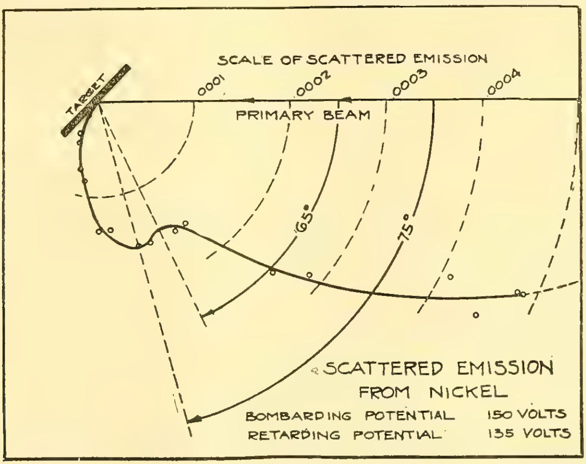

FIG. 1.

age is to reduce the number of electrons caught and to increase the sharpness of the pattern. On decreasing the bombarding potential without altering the ratio of retarding to bombarding potential the lateral maximum moves away from the primary beam toward the plane of the target, and the ratio of the intensity of this maximum to that of the other becomes greater.

In attempting to interpret these results we have been led to consider the scattering of electrons by a positive nucleus of limited field, one for which the central force on an electron is Ee/r^2 for values of r less than ρ, and zero for all values of r greater than ρ. Such a field would exist for a concentrated positive charge E surrounded by a spherical shell of uniformly distributed charge $-E$ and of radius ρ. The field of a system comprising a central positive nucleus of n electronic charges surrounded by n electrons uniformly distributed over the surface of a sphere of radius ρ will also be roughly of this nature, provided n is not too small. Neglecting the change of mass of the bombarding electrons while traversing the field within the shell it turns out that when such a system is under random bombardment by electrons approaching on parallel lines, the number of these emerging per unit solid angle in a direction making an angle Ψ with the path of the incident beam is given by

$$I_\Psi = K\left(\frac{2\beta - 1}{(2\beta - 1)^2(1 + \cos\Psi) + (1 - \cos\Psi)}\right)^2,$$

where

$$\beta = \frac{V\rho}{E},$$

V being the potential drop through which the bombarding electrons have acquired their speed.

An examination of this expression shows that when β is very large the intensity of scattering will be small in all directions except in and near the direction $\Psi = \pi$, that is, in the direction of motion of the incident electrons. As β decreases the emerging electrons are less concentrated in this direction. For $\beta = 1$ the distribution becomes entirely independent of angle. As β decreases from unity to the value one half the scattered electrons become more and more concentrated in and near the direction $\Psi = 0$, the intensity in this direction being infinite for $\beta = 1/2$. For values of β less than 1/2 the distribution curves for the range $1 > \beta > 1/2$ are identically repeated, the distribution approaching uniformity in all directions as β approaches zero.

For a neutral system of two or more concentric shells the distribution will be broken up into various beams or lobes corresponding to groups of electrons whose trajectories pass through one, two or more of the shells. In particular a system comprising two shells will give, in an appropriate range of bombarding potentials, distribution curves similar to that shown in Fig. 1.

All of the main features of the distribution curves so far observed for the scattering from nickel seem reasonably accounted for on the supposition that a small fraction of the bombarding electrons actually do penetrate one or more of the shells of electrons which are supposed to constitute the outer structure of the nickel atom and, after executing simple orbits in a discontinuous field, emerge without appreciable loss of energy.

If the theory of the scattering here proposed proves to be the correct one, there seems no reason why the careful study of such distribution curves as shown in Fig. 1 may not reveal much of interest concerning the disposition of electrons within the atom. It is hoped to report more extensively on this work in the near future.

C. Davisson,
C. H. Kunsman

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THE ATOMIC WEIGHT OF BORON

The application of positive-ray analysis by Aston[1] has yielded the evidence of existence of two isotopes of boron with atomic weights 10 and 11, in accordance with the prediction of Harkins.[2] Although the result of Smith

[1] *Phil. Mag.*, *40*, 628 (1920).

[2] *Jour. Amer. Chem. Soc.*, *42*, 1988 (1920).

and van Haagen's[3] recent determination of the atomic weight of boron, 10.900, indicates the proportions of these isotopes as nearly 1 to 9, the relative intensities of the positive-ray spectra[4] point to a considerably larger proportion of the lighter isotope. Since we have redetermined the atomic weight of boron by analysis of the chloride and bromide, and have obtained a result more nearly in accord with Aston's experiments than with those of Smith and van Haagen, it seems advisable to state the outcome of our preliminary experiments, without waiting for the completion of the investigation.

Boron was obtained by reduction of boric oxide with an excess of magnesium and extraction with either hydrochloric or hydrobromic acid. To prepare the chloride, dry chlorine was passed over the boron at about 700°. To prepare the bromide, helium saturated with bromine nearly at the boiling point of the latter substance was passed over boron at 700°. After removal of the excess of halogen with mercury both halides were repeatedly distilled with the use of Hempel fractionating columns in sealed all-glass vessels, with complete exclusion of air. Quantitative testing even before the completion of the fractionation showed the absence of silicon halides which constituted the worst impurity. Material was collected for analysis in sealed glass bulbs. Analysis was effected by comparison with silver in the usual way.

The results of the analysis of the chloride agree with those of the bromide in yielding the value 10.83 ± 0.01 for the atomic weight of boron. On the assumption that constant boiling mixtures with the halogen acids were not formed and that no separation of the eight possible combinations of two isotopes of both boron and chlorine took place, this new value for the atomic weight of boron indicates the proportion of the heavier isotope to be about five times that of the lighter.

G. P. Baxter,
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[3] Car. Inst. Pub., No. 267 (1918).

[4] Aston, *loc. cit.*

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

Isomeric alkyl-pyrimidines and color phenomena: Arthur W. Dox and Lester Yoder. A series of alkyl-diketo-pyrimidines was prepared by condensing alkyl-malonic esters with amidines. In this series four types of isomerism occur, of which the following derivatives are examples: (a) 5-butyl and 5,5-diethyl; (b) 5-phenyl-2-methyl and 5-methyl-2-phenyl; (c) 5-isoamyl-2-phenyl and 5,5-diethyl-2-p-tolyl; (d) 5-allyl and cyclobutane-1,5-spiro. Some of these derivatives are white, others are bright yellow. Color is dependent upon the presence of an aromatic group on the 2-carbon and a labile hydrogen on the 5-carbon. The latter makes possible a rearrangement into a tautomeric enolic form with three double linkages in the ring. The only exception to the color rule is the spiro derivative, which is yellow. Spectroscopic examination of a typical yellow derivative showed an absorption band in the violet between 260 and 330 $\mu\mu$.

An octet formula for benzene: Ernest C. Crocker. Proposed formula is ring of six carbon atoms acting as single complex atom. Individual carbons bonded together by sharing single pairs of electrons (single bonds), with hydrogens associated with pairs of electrons, as usual. The six excess electrons of system are "aromatic" electrons, and vibrate between the carbons, in unison. "Aromatic" electrons cause two distinct patterns, o.p., and m., according to the influence of substituents in the ring. The theory accounts well for mono, di and tri substitution products of benzene. It accounts for aromatic structure in general; particularly thiophene, furane, pyrrol, naphthalanene, and anthracene.

Diisopropylhydrazine. J. R. Bailey, W. A. Noyes and H. L. Lochte. Diisopropylhydrazine can be easily prepared by treating a solution containing acetone, hydrazine chloride, gum arabic and colloidal platinum with hydrogen under pressure. Dimethylketazine $(CH_3)_2C{:}N{-}N{:}C(CH_3)_2$ is at first formed and this is reduced to diisopropylhydrazine, $(CH_3)_2CHNHNHCH(CH_3)_2$. The latter is a monacid base, which forms stable salts. The free base is very easily oxidized, even by exposure to the air, probably forming an azo compound. The investigation of this and other relations will be continued.

The chlorination products of formanilide: W. Lee Lewis and R. S. Bly. When formanilide is chlorinated in the presence of chlorides of sulfur

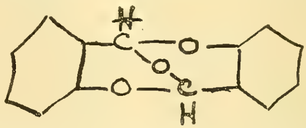
or phosphorus the principal product is 2,4-dichloroformanilide. With thionyl chloride, however, the following products were isolated: 2,4-dichloroformanilide, phenylimido phosgene, and mono- and di-chloro phenylimido phosgene. The last three compounds were identified by their conversion into the corresponding triphenyl guanidines, urethanes, and acetanilides.

The preparation of dialkyl mercury compounds from the Grignard reagent: C. S. Marvel and V. L. Gould. Diphenyl mercury, dibenzyl mercury and dicyclohexyl mercury have already been prepared from the Grignard reagent and mercuric chloride, but only in poor yields. This method may be applied to the preparation of various diolkyl mercury compounds in yields of 45–65 per cent., if the proper precautions are taken. In this reaction there is formed first, an alkyl mercury halide which is then converted into the dialkyl compound. The first step goes easily but a large excess of the Grignard reagent and long heating are necessary to bring about the second. The unreacted magnesium must be removed from the Grignard reagent solution in order to avoid reduction of the mercuric halide and consequent lowering of the yield.

The chlorination of 5-hydroxy-1,4-naphthoquinone (juglone): Alvin S. Wheeler and Paul R. Dawson. The chlorination of juglone in hot glacial acetic acid solution yields dichlorojuglone (A), probably the 2,8-isomer, orange red needles, m.151°. Benzoyl derivative, yellow needles, m.225°. Sodium salt, indigo blue, a direct dye for silk and wool. Alcoholic caustic soda gives a monochlorohydroxy-juglone, yellowish brown needles, m.191°. Diacetyl derivative, yellow needles, m.147°. Monochloro-anilino-juglone, obtained by boiling A with aniline in alcohol, violet red needles, m.222°; o-toluino derivative, dark red needles, m.151°; p-toluino derivative, deep violet needles, m.235°. So far no oxidation products of A have been obtained which might locate the chlorine atoms.

Kelp tar oils: Alvin S. Wheeler and H. M. Taylor. The kelp tar oils came from the Summerland, California, kelp plant of the U. S. Department of Agriculture and were given to us for study by Mr. J. W. Turrentine, in charge. The oil is a mixture of compounds, for we found the boiling point to range from 200° to 300° at atmospheric pressure and from 50° to 170° at 12 mm. In the latter case two thirds of the distillate came over between 110° and 150° and 25 per cent. of the oil remained behind as pitch. The oils dissolve in all organic solvents and are unaffected by most reagents. The reaction with bromine is violent and hydrobromic acid is evolved. The redistilled product contains bromine. Molecular weight determinations of fractions from low to high boiling points gave values from 124 to 165. Specific gravity ranges around the point 0.94 and refractive index about 1.46. Hydrogenation and bromination studies are in progress.

The structure of disalicylaldehyde: Roger Adams and M. F. Fogler. When salicylaldehyde is heated with acid chlorides, it is converted into disalicylaldehyde, a white solid, m.131°. This substance has been studied by previous investigators and shown to have the following properties: empirical formula $C_{14}H_{10}O_3$, stable to sodium hydroxide solution, unstable to concentrated sulphuric acid yielding two moles of salicylaldehyde; shows no reaction which would indicate a phenol or aldehyde group. No satisfactory formula has yet been suggested for this substance. The following one is proposed:



This structure is a double acetal and agrees with the properties above mentioned. The synthesis of analogous compounds which have the same chemical properties has been accomplished. New methods of preparation for disalicylaldehyde indicate that it has an acetal structure.

Anthraquinone thioethers: M. S. Hoffman and E. E. Reid. The study of the replacement of the sulphuric acid group in alpha anthraquinone sulphonic acid has been continued with the use of a variety of mercaptans, isopropyl, benzyl, nitrobenzyl, monothio-glycol, etc., and a great variety of anthraquinone thioethers thus prepared. Most of these have been oxidized to the sulphones.

Some derivatives from p-nitrothiophenol: W. R. Waldron and E. E. Reid. A large number of bases of the benzidine type have been prepared, various groups $—CH_2—$, $—CH_2S—$, $—CH_2SCH_2—$, etc., being introduced between the two rings. In particular bases have been made from mustard gas which are readily converted into azo dyes. The whole work is a study of constitution and color.

The reaction of propylene, butylene, and amy-

lene with selenium monochloride: C. E. BOORD AND FRED F. COPE. *Bis* (β chloropropyl) selenide, bis (β chlorobutyl) selenide and bis (β chloroamyl) selenide and their respective dichlorides were described. The reaction between olefines and selenium monochloride both when the olefine is in excess and when the monochloride is in excess were discussed. Evidence was offered to show that selenium monochloride has the unsymmetrical structure.

The use of olefines in the preparation of alkyl phenols (preliminary report): C. E. BOORD, A. J. YANEY AND C. W. HOLL. A simple apparatus for the laboratory preparation of ethylene, propylene, butylene, and amylene is described. A description of the preparation of amylphenol and amyl catechol by the interaction of amylene and the phenol in the presence of anhydrous ferric chloride is given. An extension of the reaction between olefines and phenols in the presence of anhydrous chlorides for the preparation of alkyl phenols is proposed. It is also proposed to use this reaction in a study of the mechanism of the Friedel-Crafts reaction.

The action of sulphuric acid on 1-phenylnaphthalene-2-3-dicarboxylic acid: M. L. CROSSLEY. It has been shown by previous investigators that 1-phenylnaphthalene-2-3-dicarboxylic acid is converted by sulphuric acid into allochrysoketonecarboxylic acid. I have found that if the reaction is carried out at a higher temperature than that at which the ketone acid is formed, a product differing from the ketone acid and having the formula $C_{21}H_{13}O_4$ is obtained. This forms an ethyl ester of the formula $C_{32}H_{17}O_4$. The acid crystallizes from pyridime in tufts of light yellow monoclinic needles and melts at about 375° C. without decomposition. It is insoluble in water and most organic solvents. The ester crystallizes from alcohol in long yellow needles, melting at 171° C. and is quite soluble in most organic solvents.

Addition compounds of γ-pyrones and sulfur trioxide: A. S. RICHARDSON.

Compound formation in phenol-cresol mixtures: JAMES KENDALL AND J. J. BEAVER. The isolation of stable compounds between phenol and the cresols has been cited by Dawson and Mountford as constituting an exception to the generalization that the stability of addition compounds decreases with increasing similarity in character of the components. The present authors have determined the specific conductivity, viscosity and freezing-point depression curves in benzene for all six phenol-cresol systems. Without exception, the results indicate that no increase in molecular complexity occurs on admixture. The compounds obtained by Dawson and Mountford are therefore to be regarded as substitution rather than as addition compounds, being formed by the replacement of part of an associated molecule by a homologue.

The oxidation of potassium acetate with potassium permanganate in the presence of potassium hydroxide: W. L. EVANS AND PAUL S. HINES. The literature contains conflicting statements in reference to the stability of acetates towards alkaline potassium permanganate. The results of our experiments are as follows: (*a*) Potassium acetate is oxidized to potassium oxalate with potassium permanganate in the presence of potassium hydroxide. (*b*) The production of oxalic acid is proportional to the concentration of the alkali used. (*c*) An increase in the temperature is accompanied by an increase in the production of oxalic acid. (*d*) When the oxidation is carried on for several days it is found that potassium acetate is oxidized to potassium oxalate in neutral potassium permanganate solutions. (*e*) The yield of oxalic acid increases with the time of the oxidation. (*f*) The velocity of the oxidation is very small.

The oxidation of acetol with potassium permanganate in the presence of potassium hydroxide: W. L. EVANS AND ORA L. HOOVER. (*a*) Acetic, oxalic and carbonic acids are the final products of the oxidation of acetol with potassium permanganate in the presence of potassium hydroxide. (*b*) In the absence of potassium hydroxide, acetic and carbonic acids are the sole reaction products. (*c*) Acetic acid is formed in the largest amounts in neutral permanganate solutions, although the acetic acid present in these cases is less than the amount equivalent to two carbon atoms. These facts show that more than one oxidation reaction is taking place under these conditions. (*d*) The yield of acetic acid diminishes to a certain minimum with an increase in the initial concentraton of the alkali, after which it increases to a certain constant yield with a continuing increase in the initial concentration of the alkali. (*e*) The production of carbon dioxide increases to a maximum point with an increase in the initial concentration of the alkali, after which it diminishes to a constant value. (*f*) The yield of oxalic acid is proportional to the

concentration of alkali used up to a certain constant value. (*g*) The general effect of an increase in temperature is that of an increase in the yield of oxalic acid and carbon dioxide and a decrease in the yield of acetic acid.

The oxidation of propylene glycol with potassium permanganate in the presence of potassium hydroxide: W. L. EVANS. (*a*) Acetic, oxalic and carbonic acids are the final oxidation products of propylene glycol with solutions of alkaline potassium permanganate. (*b*) Acetic and carbonic acids are the only products obtained in neutral solutions of potassium permanganate. (*c*) The oxalic acid production is proportional to the initial concentration of the alkali used. (*d*) The acetic acid production varies inversely with the initial concentration of the alkali. (*e*) At very low concentrations of alkali the production of carbonic acid is proportional to the initial concentration of the alkali. (*f*) The production of acetic acid diminishes with an increase in the temperature used. (*g*) The production of carbonic acid increases with an increase in the temperature used. (*h*) An increase in temperature has no marked effect on the production of oxalic acid.

The condensation of citral, with certain ketones and the synthesis of some new ionones: HAROLD HIBBERT AND LAURA G. CANNON. The best method for purifying citral is the one developed by Tiemann. Of the condensing agents hitherto employed, sodium ethylate is the most satisfactory, but metallic sodium is equally efficient. Better yields of a purer product have been obtained. The bisulfite method of purification is capable of general application in the purification of pseudo-ionones, giving yields of about 85 per cent. and chemically pure products. New ionones have been synthesized from methyl propyl ketone and acetophenone.

The migration of acyl from nitrogen to oxygen: L. CHARLES RAIFORD AND JOHN R. COUTURE. The present work is an extension and confirmation of that previously published from this laboratory (*J. Am. Chem. Soc.*, 41, 2068 (1919)) and was done to secure further evidence that the rearrangement involving migration of a lighter acyl from nitrogen to oxygen, when a heavier acyl is introduced into the molecule, is general for the specific case of acetyl and benzoyl, when the base employed is an orthoaminophenol. The rearrangement was found to occur with the derivatives of the base 2-amino-4-bromo-6-methylphenol. When the radicals were propionyl and benzoyl, the rearrangement was not complete, which indicates that the weight of acyl is one of the important factors in this migration.

Acylation with α-naphthoyl chloride and the migration of acyl: L. CHARLES RAIFORD AND CLARENCE E. GREIDER. (1) A further study of the general reaction indicated in the above report was carried out, using 2-aminophenol, 2-amino-4-methyl-6-bromphenol, and 2-amino-4, 6-dibromphenol as bases, and converting them into the α-naphthoyl-acetyl and α-naphthoyl-benzoyl derivatives, respectively. In each case the heavier acyl was found on nitrogen, regardless of the order in which they were introduced. (2) This study has also furnished evidence, so far as it has been carried, that α-naphthoyl chloride does not undergo the Schotten-Baumann reaction.

The migration of acyl: Effect of the relative positions of the amino and hydroxyl groups: L. CHARLES RAIFORD AND H. A. IDDLES. In a continuation of the studies mentioned above, the acetyl-benzoyl derivative of 2, 4-dibrom-3-methyl-6-aminophenol was found to undergo the rearrangement, and benzoyl was found on nitrogen; while the derivative of the isomeric base, 2, 6-dibromo-3-methyl-4-aminophenol did not suffer the migration. Here it was possible to isolate N-acetyl-O-benzoyl, and O-acetyl-N-benzoyl derivatives. The failure of this para compound to undergo this change was supported by the behavior of the derivatives of 4-aminophenol, 2, 6-dibrom-4-aminophenol, and 2-brom-4-amino-6-methylphenol.

Stability of the C–Hg linkage in mercury derivative of maleic acid. Preliminary paper: FRANK C. WHITMAN AND B. J. MARTIN. The sodium salt of hydroxymercuric maleic acid obtained from the action of sodium hydroxide on the reaction product of maleic acid with mercuric acetate contains an unstable C–Hg linkage. It reacts at once with sulfides. With sodium iodide it gives sodium maleate, sodium mercuric iodide and sodium hydroxide. The reaction is complete only on heating the mercury compound with a large excess of iodid. The calculated amount of iodide gives only one third of the calculated amount of base. If this base is neutralized and the mixture is boiled a little more base is formed. Many repetitions of this process give a total amount of base which gradually approaches the calculated volume.

CHARLES L. PARSONS
Secretary

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SOME PROBLEMS IN EVOLUTION[1]

It was nearly 100 years ago that Charles Darwin began his scientific studies in the University of Edinburgh. In this illustrious center of intellectual activity he met various friends keenly interested in natural history, and attended the meetings of scientific societies, and it was doubtless here that were sown many of the seeds destined to bear such glorious fruit many years later. No more fitting subject, I think, could be found for an address than certain problems relating to his doctrine of evolution. That controversy perpetually rages round it is a healthy sign. For we must take care in science lest doctrine should pass into dogma, unquestioned and accepted merely on authority. So from time to time it is useful to reexamine in the light of new knowledge the very foundations on which our theories are laid.

Perhaps the best way of treating these general subjects is by trying to answer some definite questions. For instance, we may ask: "Why are some characters inherited and others not?" By characters we mean all those qualities and properties possessed by the organism, and by the enumeration of which we describe it; its weight, size, shape, color, its structure, composition and activities. Next, what do we mean by "inherited"? It is most important, if possible, clearly to define this term, since much of the controversy in writings on evolution is due to its use by various authors with a very different significance—sometimes as mere reappearance, at other times as actual transmission or transference from one generation to the next. Now, I propose to use the word inheritance merely to signify the reappearance in the offspring of a character possessed by the ancestor—a fact

[1] Address of the president of Section D—Zoology—British Association for the Advancement of Science, Edinburgh, September, 1921.

which may be observed and described, regardless of any theory as to its cause. Our question, then, is: "Why do some characters reappear in the offspring and others not?"

It is sometimes asserted that old-established characters are inherited, and that newly begotten ones are not, or are less constant, in their reappearance. This statement will not bear critical examination. For, on the one hand, it has been conclusively shown by experimental breeding that the newest characters may be inherited as constantly as the most ancient, provided they are possessed by both parents.[2] While, on the other hand, few characters in plants can be older than the green color due to chlorophyll, yet it is sufficient to cut off the light from a germinating seed for the greenness to fail to appear. Again, ever since Devonian times vertebrates have inherited paired eyes; yet, as Professor Stockard has shown, if a little magnesium chloride is added to the sea-water in which the eggs of the fish *Fundulus* are developing, they will give rise to embryos with one median cyclopean eye! Nor is the suggestion any happier that the, so to speak, more deep-seated and fundamental characters are more constantly inherited than the trivial or superficial. A glance at organisms around us, or the slightest experimental trial, soon convinces us that the apparently least-important character may reappear as constantly as the most fundamental. But while an organism may live without some trivial character, it can rarely do so when a fundamental character is absent, hence such incomplete individuals are seldom met in Nature.

Yet undoubtedly some characters reappear without fail and others do not. If it is neither age nor importance, what is it that determines their inheritance? The answer is that for a character to reappear in the offspring it is essential that the germinal factors and the environmental conditions which cooperated in its formation in the ancestor should both be present. Inheritance depends on this condition being fulfilled. For all characters are of the nature of responses to environment,[3] they are the products or results of the interaction between the factors of inheritance (germinal factors) and the surrounding conditions or stimuli. This power of response or reaction is no mysterious property of organisms—it is the effect produced, the disturbance brought about by the application of a stimulus. All the special properties and activities of living organisms ultimately depend on their metabolism, of which growth and reproduction are the chief manifestations. The course of metabolism, and, consequently, the development in the individual of a character, is molded or conditioned by the environmental stimuli under which it takes place. On the other hand, the living substance, protoplasm, which is undergoing metabolism, is the material basis of the organism. It has a specific composition and structure peculiar to the particular kind of organism concerned, and this is handed on to the offspring in the germ-cells from which starts the new generation. The inheritance of a character is due, then, not only to the actual transmission or transference of this specific "germ-plasm" containing the same factors of inheritance (germinal factors) as those from which the parent developed, but also to this factorial complex developing under the same conditions (environmental stimuli), as those under which the parent developed. Any alteration either in the effective environmental stimuli or in the germinal factors will produce a new result, will give rise to a new character, will cause the old character to appear no longer.

Now what is actually transmitted from one generation to the next is the complex of germinal factors. Hence we should carefully distinguish between transmission and inheritance.

2 We purposely set aside complications due to hybridization and Mendelian segregation, which do not directly bear on the questions at issue.

3 In a letter to *Nature* Sir Ray Lankester long ago drew attention to the importance of this consideration when discussing inheritance. He also pointed out that Lamarck's first law, that a new stimulus alters the characters of an organism, contradicts his second law, that the effects of previous stimuli are fixed by inheritance. (*Nature*, Vol. LI., 1894.)

Much of the endless confusion and interminable controversies about the inheritance of so-called "acquired characters" is due to the neglect of this important distinction. For it is quite clear that whereas factors may be transmitted, characters as such never are. The characters of the adult, being responses, are not present as such in the fertilized ovum from which it develops, they are produced anew at every generation.[4] No distinction in kind or value can be drawn between characters.

If some are inherited regularly and others are not, the distinction lies not in the nature or mode of production of the characters themselves, but in the constancy of the factors and conditions which give rise to them. Thus, although there is only one kind of character, there are two kinds of variation.

Much of the confusion in evolutionary literature is, I think, due to the use of the word variation in a loose manner. Sometimes it is taken to mean the degree of divergence between two individuals; sometimes the character itself in which they differ, such as a color or spot on a butterfly's wing, at other times a variety or race differing from the normal form of the species. If clearness of thought and expression is to be attained, the word variation should mean the extent or degree of difference between two individuals or between an individual and the average of the species, the divergence of the new form from the old; not a new character or assemblage of characters, but a difference which can be measured or at least estimated. We shall then find that a variation is of one of two kinds (which may, of course, be combined): the first kind is due to some change in the complex of germinal factors.

The second kind, to which the name mutation has been applied, will, under constant conditions, be inherited since the new complex of factors will be transmitted to subsequent generations. The first kind of variation, which has been called a modification, will also be inherited, provided, of course, the change of stimulus persists. In either case, new characters will result. But here, again, we must be careful not to apply the terms mutation and modification to the characters themselves, as is so often done;[5] for we then reintroduce the confusion already exposed in the popular but misleading distinction between "acquired" and "non-acquired" characters. The characters due to mutation or modification are, of course, indistinguishable by mere inspection, and can only be separated by experiment. A mutation once established should give rise, under uniform conditions, to a new heritable character, and may be detected by crossing with normal members of the species.

So far observations and tests have shown that new characters due to modification only reappear so long as the new stimulus persists. The difference lies not in the value or permanence of the new character, but in the causes which give rise to it.[6]

It is little more than a platitude to state that, for the production of an organism or of any of its characters, both germinal factors and environmental stimuli are necessary, and that if evolution is to take place there must be change in one or both. Yet the changes in the factors may be held to be the more important.

[4] In other words, all characters are "acquired during the lifetime of the individual," and "inherited" in the sense here defined has just the same meaning. Much the same view was advocated by Professor A. Sedgwick in his address to this Section at Dover in 1899, and it has also been developed by Dr. Archdall Reid and others.

[5] The name "mutation" might be given to the alteration in the factors instead of the variation due to it. The latter might then be termed a mutational variation and would be opposed to a modificational variation. At present the term "mutation" is applied to three different things: the factorial change, the variation or difference, and the new product response or character.

[6] We might perhaps distinguish the two cases by calling them constant and inconstant characters, or "natural" and "acquired," as is commonly done when describing immunity. It should be meant thereby that one is acquired usually (under normal conditions), the other occasionally (when infection occurs). Error creeps in when the term "acquired" is opposed to "non-acquired" or to "inherited."

In an environment which on the whole alters but little, evolution progresses by the cumulation along diverging lines of adaptation of new characters due to mutation. Thus natural selection indirectly preserves those factorial complexes which respond in a favorable manner. In other words, an organism, to survive in the struggle for existence, must present that assemblage of factors of inheritance which, under the existing environmental conditions, will give rise to advantageous characters.

In answer to a further question, let us now try to explain what we mean when we contrast the organism with its environment. In its simplest and most abstract form a living organism may be likened to a vortex. That mixture of highly complex proteins we call protoplasm, the physical basis of life, is perpetually undergoing transformations of matter and energy, so long as life persists. Towards the center of the vortex the highest compounds are continually being built up and continually being broken down; new material (food, water, oxygen) and energy are brought in at the periphery, and old material and energy (work and heat) thrown out. The principle of the conservation of energy and matter holds good in organized living processes as it does in the inorganic world outside. This is the process we call metabolism, and it is at the base of all the manifestations of life. From the point of view of biological science life is founded on a complex and continuous physico-chemical process of endless duration so long as conditions are favorable; just as a fire will continue to burn so long as fuel is at hand. No one step, no single substance, can be said to be living; the whole chain of substances and reactions, every link of which is essential, constitutes the life-process. A stream of non-living matter with stored-up energy is built up into the living vortex, and again passes out as dead matter, having yielded up the energy necessary for the performance of the various activities of the organism. If more is taken in than is given out it will grow and sub-divide. The complexity of the organism may increase by the formation of subsidiary, more or less interdependent, vortices within it. The perpetual growth and transmission of factors of inheritance, the continuity of the germ-plasm, is but another aspect of the continuity of the metabolic process forming the basis of the continuity of life in evolution.

But all the environmental stimuli are not external to the organism. Just as the various steps in the metabolic process are dependent on those which preceded them, so when an organism becomes differentiated into parts, when the main process becomes subdivided into subsidiary ones, these react on each other. What is internal to the whole becomes external to the part. An external stimulus may set up an internal metabolic change, giving rise to a response whose extent and nature depend on the structure of the mechanism and its state when stimulated, that is to say, on the effect of previous responses. Such a response may act as an internal stimulus giving rise to a further response, which may modify the first, and so on. Parts thus become marvelously fitted to set going, inhibit, or regulate each other's action; and thus arises that power of individual adaptation, or self-regulation, so characteristic of living organisms. The processes of temperature regulation, of respiration, of excretion are examples of such delicate self-regulating mechanisms in ourselves. But one of the great advantages thereby gained by organisms is that they can regulate their own growth and ensure their own "right" development. Whereas the simplest plants and animals are to a great extent, so to speak, at the mercy of their external environment, except in so far as they can move from unfavorable to more favorable surroundings; whereas their characters appear in response to external stimuli which may or may not be present, and over which they have little or no control—the higher organisms (more especially the higher animals), as it were, gradually substitute internal for external stimuli. Food material is provided in the ovum, and the size, structure and time of appearance of various characters are regulated to a great extent by use and by the secretions of various

endocrinal glands, the action of which has been so successfully studied, among others, by Sir Sharpey Schaffer in this University. Thus, as is well shown in man, the higher animals acquire considerable independence, and are little affected in their development by minor changes of environment. Inheritance is thus made secure by ensuring that the necessary conditions are always present.

We may seem to have wandered far from our original question; but the answer now appears to be that only those characters can be regularly inherited which depend for their appearance on conditions always fulfilled in the normal environment (external or internal); and those characters will not be regularly inherited which depend on stimuli that may or may not be present. Thus, while the offspring of a dark-skinned race will be dark in whatever climate they are born, those of a fair-skinned race will be born fair, but may be darkened by sun-burn, if they spend their holiday in the open.

Now it will be said, and not without some truth, that all this is mere commonplace admitted by all; but, if so, it is, I think, often ignored or misunderstood in discussions on heredity, more especially in semi-popular writings, and sometimes even in scientific works. However, I quite willingly admit that the real problems Darwin left to be solved by the evolutionist are the nature of the germinal factors themselves, and more especially the origin of the differences between them, the origin of those changes which give rise to mutations.

That these factors[7] must at least be self-propagating substances, subsidiary vortices in the main stream of metabolizing living protoplasm, is certain, since they grow and multiply repeatedly, to be distributed to new generations of germ-cells. That they may be relatively constant and remain unaltered for generations seems also certain, since organisms or their parts can continue almost unchanged for untold ages. That they can act independently, can be separately distributed into different germ-cells, and can be re-combined seems likewise to have been proved by the brilliant work of Mendel and his followers. So independent and constant do they appear to be that modern students of heredity tend to treat them as so many beads in a row, as separate particles themselves endowed with all the properties of independent living organisms, the very properties we wish to explain. While not prepared to accept these views without qualification, it seems to me that it can scarcely be doubted that some such units must exist whether in the form of discrete particles or merely of separable substances. But not until these factors have been brought into relation with the general metabolism of the organism, as links in the chain of processes, will the problem of inheritance approach solution. If the theory is to be completed it must attempt to explain how they come to differ, how their orderly behavior is regulated, in what functional relation they stand to each other, what is the metabolic bond between them. That harmonious processes may be carried out by discrete elements in cooperation is shown in cases of symbiotic combinations such as the lichens, or the green algæ in such animals as Hydra and Convoluta. Here an originally independent organism takes its place and does its work regularly in another organism, and may even be propagated and transmitted from one generation to the next in the germ-cell! Most instructive, also, are the recently studied cases of bacteria and yeasts living regularly in certain special tissues of various species of insects, where they exert a definite influence on the metabolism (see the works of Pierantoni, Buchner, Gla-

[7] Herbert Spencer's "physiological units," Darwin's "pangens," Weismann's "determinants," are all terms denoting factors, but with somewhat different meanings. More recently Professor W. Johannsen ("Elemente der exakten Erblichkeitslehre," 1909) has proposed the term "gene" for a factor, "genotype" for the whole assemblage of factors transmitted by a species, and "phenotype" for the characters developed from them. This clear system of nomenclature, although much used in America, has not been generally adopted in this country.

ser). These no doubt are mere analogies, but they serve.

In all probability, then, factors of inheritance exist, and the fundamental problem of Biology is, how are the factors of an organism changed, or how does it acquire new factors? In spite of its vast importance, it must be confessed that little advance has been made towards the solution of this problem since the time of Darwin, who considered that variation must ultimately be due to the action of the environment. This conclusion is inevitable, since any closed system will reach a state of equilibrium and continue unchanged, unless affected from without. To say that mutations are due to the mixture or reshuffling of preexisting factors is merely to push the problem a step farther back, for we must still account for their origin and diversity. The same objection applies to the suggestion that the complex of factors alters by the loss of certain of them. To account for the progressive change in the course of evolution of the factors of inheritance and for the building up of the complex it must be supposed that from time to time new factors have been added; it must further be supposed that new substances have entered into the cycle of metabolism, and have been permanently incorporated as self-propagating ingredients entering into lasting relation with preexisting factors. We are well aware that living protoplasm contains molecules of large size and extraordinary complexity, and that it may be urged that by their combination in different ways, or by the mere regrouping of the atoms within them, an almost infinite number of changes may result, more than sufficient to account for the mutations which appear. But this does not account for the building up of the original complex. If it must be admitted that such a building process once occurred, what right have we to suppose that it ceased at a certain period? We are driven, then, to the conclusion that in the course of evolution new material has been swept from the banks into the stream of germ-plasm.

If one may be allowed to speculate still further, may it not be supposed that factors differ in their stability?—that whereas the more stable are merely bent, so to speak, in this or that direction by the environment, and are capable of returning to their original condition, as a gyroscope may return to its former position when pressure is removed, other less stable factors may be permanently distorted, may have their metabolism permanently altered, may take up new substance from the vortex, without at the same time upsetting the system of delicate adjustments whereby the organism keeps alive? In some such way we imagine factorial changes to be brought about and mutations to result.

Let it not be thought for a moment that this admission that factors are alterable opens the door to a Lamarckian interpretation of evolution! According to the Lamarckian doctrine, at all events in its modern form, a character would be inherited after the removal of the stimulus which called it forth in the parent. Now of course, a response once made, a character once formed, may persist for longer or shorter time according as it is stable or not; but that it should continue to be produced when the conditions necessary for its production are no longer present is unthinkable. It may, however, be said that this is to misrepresent the doctrine, and that what is really meant is that the response may so react on and alter the factor as to render it capable of producing the new character under the old conditions. But is this interpretation any more credible than the first?

Let us return to the possible alteration of factors by the environment. Unfortunately there is little evidence as yet on this point. In the course of breeding experiments the occurrence of mutations has repeatedly been observed, but what led to their appearance seems never to have been so clearly established as to satisfy exacting critics. Quite lately, however, Professor M. F. Guyer, of Wisconsin, has brought forward a most interesting case of the apparent alteration at will of a factor or set of factors under definite well-controlled conditions.[8] You will re-

[8] *American Naturalist*, Vol. LV., 1921; *Jour. of Exper. Zoology*, Vol. XXXI., 1920.

member that if a tissue substance, blood-serum, for instance, of one animal be injected into the circulation of another, this second individual will tend to react by producing an anti-body in its blood to antagonize or neutralize the effect of the foreign serum. Now Professor Guyer's ingenious experiments and results may be briefly summarized as follows. By repeatedly injecting a fowl with the substance of the lens of the eye of a rabbit he obtained anti-lens serum. On injecting this "sensitized" serum into a pregnant female rabbit it was found that, while the mother's eyes remained apparently unaffected, some of her offspring developed defective lenses. The defects varied from a slight abnormality to almost complete disappearance. No defects appeared in untreated controls, no defects appeared with non-sensitized sera. On breeding the defective offspring for many generations these defects were found to be inherited, even to tend to increase and to appear more often. When a defective rabbit is crossed with a normal one the defect seems to behave as a Mendelian recessive character, the first generation having normal eyes and the defect reappearing in the second. Further, Professor Guyer claims to have shown that the defect may be inherited through the male as well as the female parent, and is not due to the direct transmission of anti-lens from mother to embryo *in utero*.

If these remarkable results are verified, it is clear that an environmental stimulus, the anti-lens substance, will have been proved to affect not only the development of the lens in the embryo, but also the corresponding factors in the germ-cells of that embryo; and that it causes, by originating some destructive process, a lasting transmissible effect giving rise to a heritable mutation.

Professor Guyer, however, goes farther, and argues that, since a rabbit can also produce anti-lens when injected with lens substance, and since individual animals can even produce anti-bodies when treated with their own tissues, therefore the products of the tissues of an individual may permanently affect the factors carried by its own germ-cells. Moreover he asks, pointing to the well-known stimulative action of internal secretions (hormones and the like), if destructive bodies can be produced, why not constructive bodies also? And so he would have us adopt a sort of modern version of Darwin's theory of pangenesis, and a Lamarckian view of evolutionary change.

But surely there is a wide difference between such a poisonous or destructive action as he describes and any constructive process. The latter must entail, as I tried to show above, the drawing of new substances into the metabolic vortex. Internal secretions are themselves but characters, products (perhaps of the nature of ferments) behaving as environmental conditions, not as self-propagating fatcors, molding the responses, but not permanently altering the fundamental structure and composition of the factors of inheritance.

Moreover, the early fossil vertebrates had, in fact, lenses neither larger nor smaller on the average than those of the present day. If destructive anti-lens had been continually produced and had acted, its effect would have been cumulative. A constructive substance must, then, have also been continually produced to counteract it. Such a theory might perhaps be defended; but would it bring us any nearer to the solution of the problem?

The real weakness of the theory is that it does not escape from the fundamental objections we have already put forward as fatal to Lamarckism. If an effect has been produced, either the supposed constructive substance was present from the first, as an ordinary internal environmental condition necessary for the normal development of the character, or it must have been introduced from without by the application of a new stimulus. The same objection does not apply to the destructive effect. No one doubts that if a factor could be destroyed by a hot needle or picked out with fine forceps the effects of the operation would persist throughout subsequent generations.

Nevertheless, these results are of the greatest interest and importance, and, if corrob-

orated, will mark an epoch in the study of heredity, being apparently the first successful attempt to deal experimentally with a particular factor or set of factors in the germ-plasm.

There remains another question we must try to answer before we close, namely, "What share has the mind taken in evolution?" From the point of view of the biologist, describing and generalizing on what he can observe, evolution may be represented as a series of metabolic changes in living matter molded by the environment. It will naturally be objected that such a description of life and its manifestations as a physico-chemical mechanism takes no account of mind. Surely, it will be said, mind must have affected the course of evolution, and may indeed be considered as the most important factor in the process. Now, without in the least wishing to deny the importance of the mind, I would maintain that there is no justification for the belief that it has acted or could act as something guiding or interfering with the course of metabolism. This is not the place to enter into a philosophical discussion on the ultimate nature of our experience and its contents, nor would I be competent to do so; nevertheless, a scientific explanation of evolution can not ignore the problem of mind if it is to satisfy the average man.

Let me put the matter as briefly as possible at the risk of seeming somewhat dogmatic. It will be admitted that all the manifestations of living organisms depend, as mentioned above, on series of physico-chemical changes continuing without break, each step determining that which follows; also that the so-called general laws of physics and of chemistry hold good in living processes. Since, so far as living processes are known and understood, they can be fully explained in accordance with these laws, there is no need and no justification for calling in the help of any special vital force or other directive influence to account for them. Such crude vitalistic theories are now discredited, but tend to return in a more subtle form as the doctrine of the interaction of body and mind, of the influence of the mind on the activities of the body. But, try as we may, we can not conceive how a physical process can be interrupted or supplemented by non-physical agencies. Rather do we believe that to the continuous physico-chemical series of events there corresponds a continuous series of mental events inevitably connected with it; that the two series are but partial views or abstractions, two aspects of some more complete whole, the one seen from without, the other from within, the one observed, the other felt. One is capable of being described in scientific language as a consistent series of events in an outside world, the other is ascertained by introspection, and is describable as a series of mental events in psychical terms. There is no possibility of the one affecting or controlling the other, since they are not independent of each other. Indissolubly connected, any change in the one is necessarily accompanied by a corresponding change in the other. The mind is not a product of metabolism as materialism would imply, still less an epiphenomenon or meaningless by-product as some have held. I am well aware that the view just put forward is rejected by many philosophers, nevertheless it seems to me to be the best and indeed the only working hypothesis the biologist can use in the present state of knowledge. The student of biology, however, is not concerned with the building up of systems of philosophy, though he should realize that the mental series of events lies outside the sphere of natural science.

The question, then, which is the more important in evolution, the mental or the physical series, has no meaning, since one can not happen without the other. The two have evolved together *pari passu*. We know of no mind apart from body, and have no right to assume that metabolic processes can occur without corresponding mental processes, however simple they may be.

Simple response to stimulus is the basis of all behavior. Responses may be linked together in chains, each acting as a stimulus to

start the next; they can be modified by other simultaneous responses, or by the effects left behind by previous responses, and so may be built up into the most complicated behavior. But, owing to our very incomplete knowledge of the physical-chemical events concerned, we constantly, when describing the behavior of living organisms, pass, so to speak, from the physical to the mental series, filling up the gaps in our knowledge of the one from the other. We thus complete our description of behavior in terms of mental processes we know only in ourselves (such as feeling, emotion, will) but infer from external evidence to take place in other animals.

In describing a simple reflex action, for instance, the physico-chemical chain of events may appear to be so completely known that the corresponding mental events are usually not mentioned at all, their existence may even be denied. On the contrary, when describing complex behavior when impulses from external or internal stimuli modify each other before the final result is translated into action, it is the intervening physico-chemical processes which are unknown and perhaps ignored, and the action is said to be voluntary or prompted by emotion or the will.

The point I wish to make, however, is that the actions and behavior of organisms are responses, are characters in the sense described in the earlier part of this address. They are inherited, they vary, they are selected, and evolve like other characters. The distinction so often drawn by psychologists between instinctive behavior said to be inherited and intelligent behavior said to be acquired is as misleading and as little justified in this case as in that of structural characters. Time will not allow me to develop this point of view, but I will only mention that instinctive behavior is carried out by a mechanism developed under the influence of stimuli, chiefly internal, which are constantly present in the normal enviromental conditions, while intelligent behavior depends on responses called forth by stimuli which may or may not be present. Hence, the former is, but the latter may or may not be inherited. As in other cases, the distinction lies in the factors and conditions which produce the results. Instinctive and intelligent behavior are usually, perhaps always, combined, and one is not more primitive or lower than the other.

It would be a mistake to think that these problems concerning factors and environment, heredity and evolution, are merely matters of academic interest. Knowledge is power, and in the long run it is always the most abstruse researches that yield the most practical results. Already, in the effort to keep up and increase our supply of food, in the constant fight against disease, in education, and in the progress of civilization generally, we are beginning to appreciate the value of knowledge pursued for its own sake. Could we acquire the power to control and alter at will the factors of inheritance in domesticated animals and plants, and even in man himself, such vast results might be achieved that the past triumphs of the science would fade into insignificance.

Zoology is not merely a descriptive and observational science, it is also an experimental science. For its proper study and the practical training of students and teachers alike, well-equipped modern laboratories are necessary. Moreover, if there is to be a useful and progressive school contributing to the advance of the science, ample means must be given for research in all its branches. Life doubtless arose in the sea, and in the attempt to solve most of the great problems of biology the greatest advances have generally been made by the study of the lower marine organisms. It would be a thousand pities, therefore, if Edinburgh did not avail itself of its fortunate position to offer to the student opportunities for the practical study of marine zoology.

In his autobiography, Darwin complains of the lack of facilities for practical work—the same need is felt at the present time. He would doubtless have been gratified to see the provision made since his day and the excellent use to which it has been put; but what seems adequate to one generation becomes insuffi-

cient for the next. We earnestly hope that any appeal that may be made for funds to improve this Department of Zoology may meet with the generous response it certainly deserves.

Edwin S. Goodrich

THE SPIRIT OF RESEARCH

The recent World War emphasized the importance of scientific investigation and as a result there has followed a vigorous campaign to promote research in America. In consequence a great deal has been published recently concerning the *mechanism* of research; how we may cooperate; how the large university with superior equipment may help the teacher in the small institution to keep alive the hope that is within him to do research work; we have bulletins issued from time to time which bring certain fields of knowledge up-to-date; we have compendia on the technique of research; in a host of different ways the machinery for doing research is being cleaned and oiled and must run infinitely better than it has in the past. This is all exceeedingly important and must be done if we are to take a share in the program of scientific investigation. Back of all this machinery, however, must be human minds and the progress we make in the search for truth is going to depend on the *spirit* which animates these human minds guiding this machinery of research and taking part in the actual investigation of the many unsolved problems about us and trying to

> Read the world's old riddles well.

In other words, the motives which prompt men to spend long hours and sleepless nights trying to fathom the depths of the unknown will determine the success individuals have in their work.

As one goes over the records of human achievements in history, there is developed in the reader a sense that the great achievements of the world have been in the realm of the spiritual. (Using that term in its broadest meaning.) The Magna Charta, the advent of the Pilgrim Fathers, the Boston Tea Party, the Declaration of Independence, the Emancipation Proclamation are events and articles having the greatest spiritual significance. Great because they were staged for the uplift of the masses and not for the aggrandizement of the few as the failures of Alexander, Napoleon and William the Second are glaring examples.

It would seem that lessons of immense value to us might be gleaned from history as an aid in stimulating the spirit of research. What have the ancients to offer us? If achievement comes by means of spiritual forces then the animus of research must be spiritualized. Too much have we strayed from the simplicity of spirit which ruled the mind of the savant on the isle of Penikese who had

> come in search of truth
> Trying with uncertain key
> Door by door of mystery.

Too much have we been stimulated by personal ambition in our "search for truth." Promotion, because of the amount of research we do is not the spiritualization sought for in this plea. The fundamental virtue of the investigator is a passion for truth whatever it be and through whatever channels it may come. As Bosworth says,

> One's only safety consists in a fair treatment of facts. One fact fairly treated leads to another, and this to another. Facts treated as they ought to be treated lead always to a larger life.

This means not only a larger life for the investigator but more particularly for the great human family about him. Imbued with this spirit the seeker after truth goes in its search with the altruistic ambition of making the world a better place to live in, in every sense of the word "making it safe for democracy."

> Not of the sunlight,
> Not of the moonlight,
> Not of the starlight!
> O young Mariner,
> Down to the haven
> Call your companions,
> Launch your vessel,
> And crowd your canvas,
> And, e'er it vanishes

Over the margin,
After it, follow it,
Follow the gleam.

There is a grave danger for the spirit of research when the chief criterion for the advancement of an individual in his position is his ability to turn out voluminous material describing his experiments. This motive prompting the researcher tends more and more to satisfy personal ambition. There will gradually appear a greater amount of polemical writing and controversies over priority of discovery. Nor is this all or the worst of the results attained by such a stimulus to research. Inaccuracies and carelessness in obtaining results are inevitable, it is the logical outcome of a system where bulk and not quality weighs so heavily in seeking promotion. This tendency we are all aware of, not only in individuals but we recognize it as characteristic of nations as well. After all what difference does it make through whom truth is revealed if all can enjoy its fruits?

On the other hand, that land whose cricket and other sports have imbued its citizens with a sense of the "sport for the game's sake" has contributed a succession of epoch makers in the field of science that makes one wonder whence the inspiration of it all. One can not imagine the immortal Newton worrying very much about the status of his position because the first computation concerning the force of gravity due to the earth at the moon did not yield results as he had anticipated. To him and a great host of his fellow countrymen succeeding him it was sufficient to seek first the kingdom of truth, leaving it to others to judge whether the honors of earth, if they had any value, would be added as a natural result of ability. Is it not worth while for us of America, young in the research field, to consider seriously the motives which are to prompt our endeavors in the search for truth? The first motive leads to mediocre results while the latter is characterized by those discoveries which are epoch making. Shall personal ambition or the desire to be "a friend to man" surge through our endeavors? One class who followed the gleam of truth was hypocritical, men who seemed to have, and wished to seem to have the prestige of scientific distinction without actually possessing it. The other class adopted as their ideal those words which must be the true sentiment of every creative worker in every field of human knowledge:

And only the Master shall praise us, and only the Master shall blame;
And no one shall work for money, and no one shall work for fame;
But each for the joy of working, and each, in his separate star,
Shall draw the Thing as he sees It for the God of Things as they are."

S. R. WILLIAMS

OBERLIN COLLEGE,
OBERLIN, OHIO

THE CONCENTRATION OF HYDROGEN IONS IN THE SOIL

A PAPER with the above title has been published in Danish in the reports from the Carlsberg Laboratory (Meddelelser fra Carlsberg Laboratoriet), Vol. 15, Nr. 1. An English edition of this paper will soon be published in *Comptes-Rendus des Travaux du Laboratoire Carlsberg,* Vol. 15, Nr. 1.

The paper contains an account of researches carried on during the years 1916 and 1920 in order to ascertain the importance of the concentration of hydrogen ions with regard to the natural distribution of plants. Analyses were made of a series of Danish plant formations with regard to their botanical constitution, and at the same time samples of the soil were taken from the places in question, and the concentration of hydrogen ions determined. In natural Danish soil it was found to vary from 3.4 to 8.0 as expressed in pH values.

When comparing the botanical analysis of the formations with the physico-chemical analysis of the soil it was immediately seen that there is rather a fixed and constant relationship between the constitution of the vegetation and the concentration of hydrogen ions in the soil, because important variations of the latter are always accompanied by vari-

ations of the constitution of the vegetation when the other factors remain the same, whereas habitats with about the same concentration of hydrogen ions and equal with regard to light and moisture carry about the same vegetation. When the material collected was statistically investigated, it was further proved that many species are only found on soil where the concentration of hydrogen ions is within a certain range of concentration of hydrogen ions characteristic for each single species. Within this is found another range with narrower limits, within which the species has its largest average frequency. It was further proved that it was possible to judge of the concentration of hydrogen ions in the soil from the constitution of the plant formations, when they did not consist of too few species; this holds good, for instance, for meadows.

The number of species found and the density of species (the number of species found on 0.1 sq. m.) were on the whole largest on soil near the neutral point; number of species and density of species become generally less as the concentration of hydrogen ions in the soil increases.

By a series of water-culture experiments it was proved that the species which are found only on very acid soil (acid soil plants) show the strongest growth in culture media with pH values near 4, whereas species which naturally grow only in soils that are neutral or but slightly acid or basic (alkaline soil plants) have the strongest growth in culture media, the pH values of which are between 6 and 7. In the slightly acid culture media in which the basic soil plants have their strongest growth the acid soil plants thrive badly and become chlorotic.

According to the theory of Hartwell and Pember[1] basic soil plants can not thrive in very acid soils, not because these plants can not stand so high a concentration of hydrogen ions as the acid soil plants, but because the very acid soils contain small quantities of dissolved aluminum compounds, which are said to be poisonous for the basic soil plants and not for the acid soil plants. This theory has been proved not to be generally valid, as experiments have shown that aluminum ions are not poisonous for all basic soil plants, generally speaking.

According to Bear[2] and others acid soil plants can make use of the nitrogen in ammonia, whereas basic soil plants require nitrate nitrogen, which makes it impossible for them to thrive in very acid soil in which nitrification is weak or wanting. Experiments showed that nitrogen from ammonia and from nitrate nitrogen are of the same value for acid soil plants and for basic soil plants, when the plants were cultivated at constant pH. If on the other hand the pH is not kept constant, the plants make the solution more acid, when the source of nitrogen is a salt of ammonia (including thereby ammonia). In this case the basic soil plants soon die, because the solution becomes too acid. The acid soil plants on the other hand last longer as they are more tolerant of acid. If the source of nitrogen is a nitrate (nitrate of ammonia excepted), the plants make the solution more alkaline and the plants die, after having first become chlorotic. The chlorosis takes place for acid soil plants when the pH value of the culture medium has the culture medium has reached a pH value reached 6.0, but for basic soil plants not till of about 7.0.

The investigations prove that the quantity of nutritive substances does not largely influence the distribution of plants. This is opposed to the results of some investigators, who consider that the acid soils are poor and the neutral and basic soils rich in such substances. It has been proved that basic soils exist which are very poor in nutritive substances, and their vegetation does not resemble that of very acid soils, which are poor in nutritive substances.

1 Hartwell, B. L., and Pember, F. R., 1918, "The presence of aluminum as a reason for the difference in the effect of so-called acid soil on barley and rye," *Soil Science*, 6, 259.

2 Bear, F. E., 1917, "A correlation between bacterial activity and lime requirement of soils," *Soil Science*, 4, 435.

It is therefore probable that the concentration of hydrogen ions of the soils has a direct rather than an indirect influence on the constitution of the vegetation.

Carsten Olsen
The Carlsberg Laboratory,
Copenhagen

THE PRESENT STATUS OF THE CONCILIUM BIBLIOGRAPHICUM

Professor Henry Ward's appreciative account of Dr. H. H. Field and his self-sacrificing work in connection with the founding and maintenance of the Concilium Bibliographicum suggests to me to make a brief statement concerning the present status of the Concilium.

I spent several weeks in July and August of this summer in a personal examination, in Zurich, of Concilium affairs, representing the National Research Council and the Rockefeller Foundation. The Council has had for some time, during the latter months of Dr. Field's life-time and since his death, in consideration the possibility of extending some aid for the maintenance and further development of the Concilium. The Foundation has manifested a similar interest with a tangible expression of it by two appropriations to assist in meeting the current expenses of the Concilium in 1920 and 1921.

On arrival in Zurich I found Concilium matters in a critical situation. Dr. Field's patriotic activities during the war had left him but little time to devote to the Concilium, and the disastrous results of war-time and after-war conditions on such international organizations as the Concilium had left things in very bad shape. Dr. Field's sudden death prevented him from even beginning a serious rehabilitation of Concilium work and finances.

After many conferences with Mrs. Field and her business friends, with Fraülein Rühl who for twenty years has been Dr. Field's chief technical assistant and was practically the only member of the Concilium staff still giving full time to its affairs, and with an official representative of the Swiss Natural Science Association, which under the terms of Dr. Field's will becomes, under certain conditions, the legatee of Dr. Field's financial interest in the Concilium, and after long and difficult examination of the business books and memoranda of the Concilium, I arranged to set up a provisional reorganization of the Concilium under the acting directorship, until January 1, 1922, without salary, of Professor J. Strohl, of the Zoological Institute of the University of Zurich.

This temporary reorganization will allow some of the most needed work of the Concilium to go forward, supported financially by the subsidies of the Swiss Government, the city of Zurich and the Rockefeller Foundation.

The Concilium, which from the business point of view, is a non-profit taking company, most of whose shares belong to the Field estate, owns an equity of some value in the building at 79 Hofstrasse which for several years has been the Concilium offices and printing rooms. It also has some assets in the way of many already printed cards, some little stock of paper, some office furniture, type and printing presses, etc. But most importantly its assets are its "good will" and subscription list. This list must have immediate attention and revision and that is part of the work now being done under the provisional arrangement.

Professor Ward and other American biologists may be assured that the Concilium is not being allowed to go to pieces without some positive efforts being exerted to save it. It is not yet time, but soon will be, for a definite statement to be issued to the American subscribers to the Concilium cards, which, I hope, will not have to include a direct appeal for money for the support of the Concilium but will appeal for a renewed interest in, and support of the organization, to be manifested by a confirmation of old subscriptions and an addition of new ones. I was much interested to discover from examination of the subscription lists that one third of all the Concilium subscribers are American.

Vernon Kellogg
National Research Council

SCIENTIFIC EVENTS

THE HIGH ALTITUDE EXPEDITION TO PERU

As has been already noted in SCIENCE, the Royal Society High Altitude Expedition to Peru sailed in the third week of November on the *Santa Teresa*. The expedition proposes to study the adaptation of man to life at or above the altitude of 14,000 ft. As compared with other localities in which this type of work has been carried out, Peru possesses certain advantages: (1) Being near the equator, the effects of altitude are less complicated by those of cold than in higher latitudes. (2) The Central Railway of Peru, the highest standard-guage railway in the world, ascends the Andes to an altitude of 15,885 ft. (3) A mining population lives and works in localities situated above 14,000 and 16,000 ft., or even higher. It is alleged, for example, that the porters at the town of Cerro de Pasco, in the Andes, raise the ores 600 ft. from the mines by carrying loads of 160 lb. of mineral many times in the day. There is probably no other population which carries on such heavy work in so rare an atmosphere. Experimental methods for the study of the circulatory and respiratory systems have advanced so much within the last ten or twenty years that the time seems ripe for their application to the extraordinarily interesting problems which life at high altitudes presents. Donations towards the expenses of the expedition have been received from the folowing: The Royal Society, the Harvard Medical School, the Carnegie Fund, the Moray Fund, the University of Toronto, the Rockefeller Institute, the Presbyterian Hospital, New York, Sir Peter Mackie, and Sir Robert Hadfield.

Members of the party are Alfred C. Redfield, assistant professor of physiology at the Harvard Medical School; Arlie V. Bock, M.D., of the Massachusetts General Hospital; Henry S. Forbes, M.D., now engaged in research work in industrial medicine at Harvard University; C. A. L. Binger, of the Rockefeller Institute, New York; and George A. Harrop, of the Presbyterian Hospital, New York. The expedition was organized by Joseph Bancroft of Cambridge University, England; he is accompanied also by Professor J. G. Meakins, of Edinburgh University, and Dr. Doggart of King's College, Cambridge, England. They carry with them an X-ray machine and a large amount of other medical apparatus.

After completing the studies at Cerro de Pasco, the investigators expect to spend a short time at Ticleo, on the watershed of the Andes. Ticleo, nearly 16,000 feet high, is the highest standard-gauge railroad station in the world. They will return by February first, and later in the year Mr. Bancroft will give a series of lectures at the Lowell Institute in Boston.

THE JOSEPH HENRY FUND OF THE NATIONAL ACADEMY OF SCIENCES

In the year 1878 a tripartite agreement was made between (1) Certain citizens of Philadelphia, (2) A Pennsylvania Insurance and Annuity Company and (3) the National Academy of Sciences, by the terms of which a fund of $40,000 face value was placed in trust with the Company, the income from which was to be paid to Professor Joseph Henry during his life and after his death to his wife and three daughters and after the death of the last survivor of these four, it was provided that the same gross sum shall be transferred to the National Academy of Sciences to be forever held in trust and the income from which shall be from time to time applied to assist "meritorious investigations in natural science especially in the direction of original research."

By the death on November 10, 1920, of the last survivor of the original beneficiaries, the capital sum passes, as of that date, into the hands of the National Academy of Sciences for purposes as indicated.

At the recent fall meeting of the Academy in Chicago, the following statement of policy of administration, submitted by the special Committee on this fund, was approved by the Academy:

Under the terms of the trust deed there is im-

posed no limitation regarding the field of science in which an award may be made. Since, however, this fund, in its original inception was organized during Professor Henry's life time for the purpose of enabling him the better to carry on his scientific work, and since it now stands, in some measure, as a monument to his name and to his contributions to science, it would seem not improper that among projects of equal merit otherwise, some preference should be shown to those which may lie nearer to the fields of work with which Professor Henry's name is usually associated. The committee does not, however, desire to impose in advance any specific limitations or restrictions, and it will therefore be prepared to consider applications from all fields of natural science.

It is probable that a certain amount of money may be avaliable for award at the meeting in April next. Applications for award should be forwarded to the Secretary of the National Academy of Sciences, Smithsonian Institution, Washington, D. C., on or before April 5, 1922.

Suggestions regarding the general problem of the most effective utilization of such a fund will be gratefully received by the chairman of the committee.

W. F. DURAND,
Chairman, Joseph Henry Fund Committee

STANFORD UNIVERSITY,
CALIFORNIA

DR. NICHOLS AND THE PRESIDENCY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DR. ERNEST FOX NICHOLS, president of the Massachusetts Institute of Technology, has resigned his office because of ill health and his resignation has been accepted by the executive committee of the corporation. He has been given leave of absence until January 4, 1922, when the next meeting of the corporation will be held and the action of the executive committee will be ratified. Dr. Nichols was inaugurated president of the institute on June 8, 1921, but has not assumed the office.

Dr. Nichols's letter to the corporation follows:

A sufficient time has now elapsed since the onset of a severe illness, which followed immediately upon my inauguration, to enable my physicians to estimate consequences. They assure me certain physical limitations, some of them probably permanent, have resulted. These, they agree, make it decidedly inadvisable for the institute or for me that I should attempt to discharge the manifold duties of president. Indeed, they hold it would be especially unwise for me to assume the grave responsibilities, to attempt to withstand the inevitable stresses and strains of office, or to take on that share in the open discussion of matters of public interest and concern inseparable from the broader activities of educational leadership.

As my recuperation is still in progress I have contended earnestly with my doctors for a lighter judgment. I feel more than willing to take a personal risk, but they know better than I, and they stand firm in their conclusions.

The success of the institute is of such profound importance to our national welfare, to the advancement of science and the useful arts, that no insufficient or inadequate leadership is sufferable. Personal hopes and wishes must stand aside.

It is therefore with deep personal regret but with the conviction that it is best for all concerned, that I tender you my resignation of the presidency of the institute and urge you to accept it without hesitation.

To you who have shown me such staunch and generous friendship it is pleasant to add that in the judgment of my physicians the physical disqualifications for the exigencies of educational administration are such as need not restrict my activities in the simpler untroubled, methodical life of scientific investigation to which I was bred. It is to the research laboratory, therefore, that I ask your leave to return.

In reply Frederick P. Fish, chairman of the executive committee of the corporation, wrote as follows:

Your letter of November 3, 1921, to the Corporation of the Massachusetts Institute of Technology was submitted to the executive committee of the institute at a meeting of the committee on November 10, 1921.

The situation set out in your letter is clearly controlling and the committee had no alternative except to accept your resignation, subject to confirmation by the corporation. As appears by the vote of the committee, copy of which I enclose, your resignation is to take effect January 4, 1922, with leave of absence until that date.

I can not adequately express the deep regret of the committee that the institute must lose your services as its president. We have all been looking forward with the utmost confidence to the sound development and continued prosperity of the institution under your leadership. We have no doubts as to the future but shall never cease to deplore that you were not permitted to make the great contribution to the work which your character, personality and training would have assured to it.

I need not add that the severance of the personal relations which have given us so much satisfaction is a source of keen regret to us all. We know, however, that you will always remain a friend of the institute and of those who are responsible for the guidance of its affairs.

The members of the committee and the friends of the institute generally, will cordially unite in wishing you a long, happy and prosperous life and large success in the work to which you propose to devote your effort.

MEETINGS OF NATIONAL SCIENTIFIC SOCIETIES

REDUCED railroad fares for those attending the Toronto meeting of the American Association for the Advancement of Science (December 27 to 31) have now been granted by the Southeastern, Western and Southwestern Passenger Associations, as well as by those named in a recent announcement (SCIENCE, 54: 353, October 14, 1921). Every member planning to attend the meeting from the regions of the Transcontinental Passenger Association should consult his local ticket agent, and purchase a ticket to the nearest main station lying within the region for which the reduced rates are available. The complete list of passenger associations granting the reduced rates is: The Canadian Passenger Association, The New England Passenger Association, The Central Passenger Association, The Southeastern Passenger Association, The Western Passenger Association, and the Southwestern Passenger Association. The rate from main stations within the regions of these associations will be a fare and one half for the round trip, on the certificate plan.

THE next meeting of the American Astronomical Society will be held on December 29–31, at Sproul Observatory, Swarthmore, Pa.

THE Ecological Society of America will hold its annual meeting at Toronto in affiliation with the American Association from December 27–30. In addition to the regular sessions of the society joint sessions will be held with the Entomological Society of America, the American Society of Zoologists and the Botanical Society of America. Members wishing to present papers should furnish the secretary with titles and brief abstracts as soon as possible. The society headquarters will be at the King Edward Hotel. Communications in regard to participation in the program and in regard to membership should be sent to the secretary, A. O. Weese, The Vivarian, Champaign, Illinois.

THE annual meeting of the Federation of American Societies for Experimental Biology, composed of the American Physiological Society, The American Society of Biological Chemists, The American Society for Pharmacology and Experimental Therapeutics, and The American Society for Experimental Pathology, will be held in New Haven under the auspices of Yale University on December 28, 29, and 30. The American Association of Anatomists will meet at the same date and place. The advantage of one and one half round trip fare on the certificate plan has already been granted by the railroads of the territory east of Chicago and St. Louis and south of the Canadian border. These rates are available to members and their friends attending the annual session. The federation meeting is under the executive chairmanship of Dr. J. J. R. MacLeod, of the University of Toronto, president of the American Physiological Society.

THE annual meeting of the Association of American Geographers, under the direction of President Ellen Churchill Semple, will be held in Washington, D. C., on December 29, 30 and 31, beginning on Thursday at one thirty. Through the courtesy of the National Geographic Society the session will be held at the society building. Morning sessions Friday and

Saturday will extend from ten to one o'clock; afternoon sessions Friday and Saturday from two thirty to five thirty. The president's address will be given at the opening of the session on Friday afternoon, and will be followed by a series of invited papers on "Trade Routes."

THE American Society of Mechanical Engineers will hold its annual meeting in New York city from December 5 to 9. The report of the committee on elimination of waste in industry of the American Engineering Council will provide the basis for the discussion.

SCIENTIFIC NOTES AND NEWS

THE Norwegian Störthing has awarded the Nobel peace prize for 1921 to Dr. Elis Stroemgren, professor of astronomy at the University of Copenhagen, for his efforts to effect reconciliation among scholars of European countries.

DR. T. C. CHAMBERLIN, of the University of Chicago, has been made a corresponding member of the Stockholm and Belgian Geological Societies.

DR. SIMON FLEXNER, the director of the Rockefeller Institute for Medical Research, New York, has been elected a corresponding member of the Vienna Society of Physicians.

PROFESSOR GEORGE GRANT MACCURDY, of Yale University, first director of the American School in France for Prehistoric Studies, has been elected a corresponding member of the Société Archéologique et Historique de la Charente.

DR. JOHN B. WHITEHEAD, dean of the engineering school and professor of electrical engineering at Johns Hopkins University, has been awarded the five thousand francs prize of the Institute Electrotechnique Montefiore of Liège, Belgium, bestowed every three years for original work on the scientific advancement in the technical application of electricity. The prize was given for an essay on "The Corona Voltmeter and the Electric Strength of Air."

THE Jenner Memorial Medal of the Royal Society of Medicine has been conferred on Sir Shirley Murphy in recognition of his work in epidemiological research.

THE University of Cambridge has presented an address to Dr. G. D. Liveing, St. John's College, formerly professor of chemistry, to commemorate the fact that he has kept by residence every term in the university for the last seventy-five years. Dr. Liveing became fellow of St. John's College in 1853, and professor of chemistry in 1861.

PRESIDENT LIVINGSTON FARRAND, of Cornell University, was elected president of The American Child Hygiene Association at its annual convention in New Haven, on November 5.

PROFESSOR FILIBERT ROTH, head of the department of forestry of the University of Michigan, was recently appointed by Governor Groesbeck as a member of the State Commission of Conservation. Professor Roth represents on the commission the forestry interests of the state.

DAVID LUMSDEN, formerly assistant professor of floriculture at Cornell University and during the last two years director of Agricultural Reconstruction at Walter Reed General Hospital, has been appointed horticulturist in the Office of Foreign Plant Quarantines, Federal Horticultural Board, Washington, D. C.

MESSRS. J. E. Walters, F. W. Schroeder, and Frank Porter, chemists at the helium plant of the Bureau of Mines at Petrolia, Texas, have been transferred to the new cryogenic laboratory of the bureau in Washington.

MR. EARLE E. RICHARDSON, who has been instructing in analytical chemistry and physics for the past four years at the Massachusetts Institute of Technology, has been appointed research physicist under Mr. L. A. Jones at the research laboratories of the Eastman Kodak Co., Rochester, N. Y.

MR. ALLEN ABRAMS has resigned as research associate from the research laboratory of applied chemistry at the Massachusetts Institute of Technology to become chief chemist for the Cornell Wood Products Co.

Dr. L. I. Shaw, assistant chief chemist of the Bureau of Mines, has been transferred to the Columbus, Ohio, ceramic experiment station of the bureau, where he will have charge of some newly organized research on refractory products.

Wilson Popenoe, agricultural explorer for the U. S. Department of Agriculture, has returned to Washington after a two years' absence in Guatemala, Costa Rica, Colombia, Ecuador, Peru and Chile. Mr. Popenoe has sent to Washington from these countries living material of numerous food-plants, including new varieties of the avocado for trial in California and Florida, several promising species of Rubus, the pejibaye palm (*Guilielma utilis*) of Costa Rica, a collection of potatoes from Ecuador and Colombia, and a superior variety of the Andean cherry (*Prunus salificolia*).

Professor Franz Doflein, now at the Zoological Institute at Breslau, Germany, is completing a revision of his "Lehrbuch der Protozoenkunde." He finds it difficult to secure in Germany access to American papers in the field of protozoology published since 1916 and will welcome the sending, from investigators in this field, of reprints of their papers.

Professor Henry Norris Russell, of Princeton University, spoke before the Physical Colloquium of the Western Electric Company in New York, recently, on the subject "Ionization in the Stars."

Professor J. H. Walton, of the department of chemistry of the University of Wisconsin, lectured before the Milwaukee Section of the American Chemical Society on November 18 on "The influence of impurities on the rate of growth of certain crystals."

At a joint meeting of the Washington Academy of Sciences, the Biological Society of Washington and the Botanical Society of Washington on November 12, Professor Arthur de Jaczewski, director of Institute of Mycology and Pathology at Petrograd, delivered an address on "The development of mycology and pathology in Russia"; Professor Nicholas I. Vavilov, director of the Bureau of Applied Botany and Plant Breeding at Petrograd, delivered an address on "Russian work in genetics and plant breeding," and Dr. Vernon L. Kellogg, permanent secretary of the National Research Council, led a discussion on "The interrelations of Russian and American scientists."

Dr. Heber D. Curtis, director of the Allegheny Observatory, lectured before the Franklin Institute at Philadelphia on November 16 on "The spiral nebulæ and their interpretation." On the following day he lectured before the Washington Academy of Sciences on "The sun, our nearest star."

The series of lectures on "The evolution of man" under the auspices of the Yale chapter of the Society of the Sigma Xi will include a lecture on "The evolution of intelligence" by the president of the university, Dr. James R. Angell.

The winter course of popular scientific lectures before the Royal Canadian Institute at Toronto was inaugurated on October 29 by a lecture entitled "Some aspects of economic entomology," by Dr. L. O. Howard, chief of the Bureau of Entomology of the U. S. Department of Agriculture. It is the purpose of the institute to have scientific men from the United States deliver lectures in this course during the coming season.

Professor Douglas W. Johnson, of Columbia University, delivered a lecture on the "Topography and strategy of the Western Front" before the officers of the Naval War College at Newport, on October 28. On November 1 he addressed the New York Post of the Society of American Military Engineers on "Geology and topography in relation to the strategy and tactics of the Great War."

We learn from *Nature* that the 168th session of the Royal Society of Arts will be opened on Wednesday, November 2, at 8 P.M., when Mr. Alan A. Campbell Swinton, chairman of the council, will deliver an experimental address on "Wireless telegraphy." Among the papers fixed for the meetings up to Christmas are the following: The work of the industrial fatigue research board, by D. R.

Wilson; Modern buildings in Cambridge and their architecture, by T. H. Lyon; The coming of age of long-distance wireless telegraphy and some of its scientific problems (Sir Henry Trueman Wood Lecture), by Professor J. A. Fleming; and The preservation of stone, by Noel Heaton.

AN inter-allied exhibition of hygiene will take place in Strasbourg on May 1, 1923, on the occasion of the centenary of Pasteur's birth. The commissioner general is Professor Borrel, the secretary general M. Emile Henry.

A SENATE joint resolution by Senator Heflin of Alabama would authorize that $50,000 be spent in the erection of a monument in the city of Washington to Major-General William C. Gorgas, former surgeon-general of the army, in commemoration of the services rendered by him to humanity.

RAYNER M. BEDELL, electrical engineer, brother of Professor Frederick Bedell, of Cornell University, died of tetanus on November 5, at Montclair, N. J.

DR. MERWIN PORTER SNELL, a member of the scientific staffs of the Smithsonian Institution and the Bureau of Fisheries in the years 1881–1889, died at his home at Stamford, Connecticut, on September 23, 1921, at the age of fifty-eight years.

.THE death is announced on October 29 of William Speirs Bruce, the oceanographer and polar explorer.

DR. FRANCIS ARTHUR BAINBRIDGE, university professor of physiology at St. Barthomew's Hospital, died on October 27th at the age of eighty-six years.

ETIENNE BOUTROUX, professor of philosophy at the Sorbonne since 1885, died in Paris on November 22, at the age of seventy-six years. During 1910 M. Boutroux delivered a series of lectures at Harvard University.

THE death is reported from Paris, at the age of seventy-two years, of the French enginer, M. Albert Sarpiaux, who had long been connected with the scheme for the construction of a tunnel under the English Channel.

DR. PIERRE HENRI SOILLIER, honorary professor of the Lyons Medical Faculty and corresponding member of the Academie de Médecine, has died at the age of eighty-eight years.

OUR attention has been called to the fact that Dr. Emil A. Budde, whose death was announced in the issue of SCIENCE for November 18th, was president of the Electrotechnical Commission and not of the Electrochemical Commission as there stated. The succession of presidents of the Electrotechnical Commission has been Kelvin, Mascart, Elihu Thomson and Budde.

THE Royal Astronomical Society of Canada will meet in Toronto with the American Association for the Advancement of Science, and will join in the program of Section D of the association.

DISCUSSION AND CORRESPONDENCE

FUR SEALS OFF THE FARALLONS

So little is known regarding the whereabouts of the Alaska Fur Seals during the period of their absence from their breeding grounds on the Pribilof Islands, that the following definite record will be of interest.

The observations here recorded were made by Mr. John Kunder, at that time keeper of the Farallon Light Station, and communicated to me by Captain H. W. Rhodes, superintendent of lighthouses, 18th district, San Francisco.

Mr. Kunder states that on or about March 4, 1920, at 9 A.M. a herd of seals appeared about two miles due south of the Farallons. They presented a compact front line about three miles in length. They were about two miles away when first observed and were moving toward the island. They appeared to stop for a moment to gaze at the object at their front, then their left wing slowed down and the right moving rapidly, the seals jumping out of the water, the line veered around in regular military formation and a new line was formed which moved off in a west-northwest direction. After completing the new formation the herd moved very fast. The line was well-formed at all times, there being few or no stragglers.

When first seen approaching, Mr. Kunder

says the commotion in the water was like a line of breakers coming from due south toward the island, but with field glasses it was easy to determine the real cause of the disturbance. Mr. Kunder estimated the number of seals in the herd at 8,000 to 10,000.

On March 10, 1917, Mr. Kunder witnessed a similar phenomenon. This herd appeared at about five o'clock in the evening, in the same locality, and its movements, appearance, and course were about the same as with the 1920 herd. The 1917 herd was, however, considerably larger than that of 1920, the number of seals in it being estimated by Mr. Kunder at 15,000. Mr. Kunder says he has never seen any single fur seals or small groups in the vicinity of the island.

So far as I am aware this is the first record of the occurrence of the fur seals in large compact herds anywhere in the open sea; they have hitherto been observed or reported only in more or less scattered numbers.

Barton Warren Evermann
California Academy of Sciences

THE PHYSICAL MUSEUM OF THE UNIVERSITY OF WISCONSIN

So much interest has been shown in this little museum that a brief description of it in the columns of Science seems worth while. It is the outgrowth of an attempt to build up on a small scale, for the benefit of our students, a collection of simple demonstration experiments such as is exhibited in, say, the Urania of Berlin. When our new laboratory was built some four years ago we arranged for a room, in size about 18×40 feet, parallel to the main corridor and separated from it by a glazed partition. In this we have gradually accumulated some forty "exhibits," each with an explanatory card setting forth the theory as simply as is consistent with scientific accuracy. While many of the exhibits are of the fixed variety, *e.g.*, the parts of an ammeter, various stages of lamp bulb construction, transparencies and the like, the most interesting demonstrations, needless to say, are those which "work."

First and foremost, of course, is the Foucault pendulum, which in this case is 1440 cm. long and occupies a special well. It is started every morning at 8 o'clock and swings over a card graduated in hours (for this latitude). It is accompanied by a small rotating table of the usual demonstration variety with a miniature Foucault pendulum. A large electrically driven gyroscope mounted in a box which may be wrestled with, gives a striking demonstration of gyroscopic reactions. A loop-the-loop model, ball on stream of water, probability board (shot), Kater pendulum and simple air-pressure demonstration are among the other mechanics exhibits. There is also a conservation-of-angular-momentum rotating platform (contrived with the aid of a Ford front-wheel bearing) on which one may stand with a dumbbell in each hand and perform this somewhat startling experiment.

The Melde experiment, various Foucault current phenomena and certain magnetic effects are all susceptible of easy demonstration, as are also simple thermo-electric effects. One of the most interesting and simple optical arrangements is a pair of plane mirrors set at a right angle. In these one may—possibly for the first time—"see himself as others see him," while reflected printed matter is readable. The explanation is almost obvious. Our two most recent and pretentious exhibits—an oscillating audion circuit and a vacuum discharge demonstration—have attracted considerable attention.

The interest shown in the museum has been very gratifying. Just now, although this is its third year, the attendance is in the neighborhood of two hundred visitors a day. It is very unusual to find less than half a dozen trying the experiments and sometimes the room is literally crowded full. The wear on certain pieces of apparatus shows graphically the thousands of times they have been handled. While drawn mostly from the student body the visitors frequently include the casual outsider who comes to take a "one-hour course in physics."

It is very difficult to estimate just what good "results" may be claimed for such a

museum. Undoubtedly many come merely to toy with the apparatus, but some few pore over the explanations and ask questions about them. That it has awakened an interest in the subject in many for the first time may be taken for granted. One very definite advantage is that it allows the instructor to refer his students to certain experiments in the museum with the request that they try them and report on the results, *e.g.*, all our elementary students determine, from its period, the length of the large pendulum.

However, while it seems eminently worth while it is needless to say that such a museum, simple as it is, will not run itself. Although it does not require the presence of an attendant, its continued demand for new experiments as well as the upkeep of the old ones would constitute a perhaps unwarranted liability on the time of the instructional force of the department if it could not, as in the present case, be entirely turned over to an ingenious and able apparatus man.

L. R. INGERSOLL

MADISON, WIS.,
November 5, 1921

HOW TO DO RESEARCH [1]

I HAVE never done any research. I am therefore able to give unbiased advice regarding it.

Research—in the broadest sense—consists largely of repairing leaks in glass tubing.

More specifically, it consists of gathering in a cell down in the Ryerson basement a weird assembly of switches, wires and glass tubing—and then keeping other students from borrowing it.

Apparatus may be borrowed or acquired. If you borrow it you are expected to return it. If you acquire it, you keep it until you are found out.

Tools at one time could be found in the student's shop. Now you find them everywhere.

[1] Read at a gathering of the graduate students in Physics of the Ryerson Physical Laboratory on a social occasion preceding Professor Milliken's departure from Chicago.

In order to do research, one must have ideas. *One* idea is sufficient. Two ideas are apt to contradict each other.

Ideas are easy to get. If you haven't any, consult Dr. Gale. He can be found adjusting gratings down in the basement.

By all means do *not* search for something original. If you think you have a *new* idea read Professor Groszkopf's articles in "Zeitschrift für So und So" published about 1700. You will find he suggested the same thing two centuries ago.

After all, it is doubtful whether even one idea is necessary. Merely get some apparatus, solder it together and take readings.

Readings are always taken through a telescope.

You will get certain numbers. Plot these numbers against other numbers which you get from variable parts of the apparatus.

If you get a straight line on plotting your observations you know at once that the results could have been predicted.

However, if you get a curve the situation is different. Examine the curve carefully for sharp bends or breaks. If you find one, you have made a discovery. These breaks are significant. Consider carefully what may have caused such breaks. Try to trace them to atomic or electronic phenomena. Draw a picture of the atom. Don't be discouraged if your picture doesn't agree with other pictures. Dr. Lunn will show it doesn't mean anything anyhow.

Having obtained a curve and concocted a theory, it is befitting that you present the whole to the Physics Club.

The Physics Club was invented to keep research students from getting the big head. It consists of a crowd of professional knockers. There is one booster. You are the booster.

It is fitting here to give you details on your conduct at the meeting.

The latter is always preceded by tea. While this is being served go into the lecture room and copy a few weird sketches of your apparatus on the board. Make everything as

complicated as possible. Also prepare a few slides. They may be shown at embarrassing moments.

As soon as the club is assembled, gaze upon them with a dreamy eye and begin your talk.

The first step is to write nine long equations on the board.

Somebody will call your attention to the fact that the fifth term of the first equation should have a minus sign.

Memorize the equations beforehand if possible. Write them rapidly.

The success of your talk will depend directly on the number of people you can shake off at this point.

Mathematics is always helpful in this way. If your audience looks too intelligent, cover the board with partial derivatives and integral signs.

Having presented the equations dwell at great length on the sub-electron, the rigidity of the ether, or the density of petrified rhubarb in Siberia.

Finally when you see that vacant stare, indicative of a temporary lapse of intelligence, steal into the eyes of the front row, it is time to stop.

Pause for effect. Gather up your books—several volumes of "Annalen der Physik" and four score and seven sheets of loose notebook paper and ask for questions.

There will always be questions. They are indicative of an intelligent audience.

Then there will be a discussion. In this *you* will have no part. However, at its close you will be convinced of three things:

First: that you were entirely wrong.

Second: that you did a fine piece of work.

Third: that it doesn't mean anything.

The moral of this paper is: It is much easier to take data than to interpret the results.

A. W. Simon

SCIENTIFIC BOOKS

Organic Dependence and Disease: their Origin and Significance. By John M. Clarke. Yale University Press, 1921. Pp. 113, 105 text figs.

In a new book, marked by deep thinking, and written with Huxleian vigor and picturesqueness of phrase, we have presented to us the philosophy of righteous living as seen by a paleontologist, a life-long student of Paleozoic faunas and floras. Beginning with a study of mutual and commensal living, we are shown how this develops into parasitism, and out of it all comes to us the true significance of ease in life and dependence. Progress, racial or individual, does not lie in this direction, and once entered upon, there is no return road to independence, the only righteous mode of living.

We need not present the evidence on which Clarke's philosophy is based, since the book itself gives this so clearly, but can go at once to the conclusions. Parenthetically, however, we would advise the reader to study along with the book under review Conklin's "The Direction of Human Evolution," a most interesting work on philosophical naturalism, showing what evolution has done for man morphologically, and what in all probability social evolution will do for him. In these two books we have revealed to us the naturalist's religion as Nature has unfolded it throughout the geological ages. As Conklin says,

> The new wine of science is fermenting powerfully in the old bottles of theology.

The purpose of Clarke's essay is to set forth the apparent controls governing the historical origin of dependent and abnormal conditions of life, and from this evidence to generalize their significance to humanity. The bases of this knowledge are Paleozoic invertebrate fossils, plus the vista of organic accomplishments through untold millions of years. The evidence is presented without embarrassing detail and the conclusions without bias, and their human concerns are of high moment.

The author states that "disease is discomfort," and agrees with Huxley that "disease . . . is a perturbation of the normal activities of a living body." In other words,

Disease is *any departure from normal living*. . . . The *entire body*, organism or creature and the *entire race* or stock to which it belongs may become abnormal through subjection to an abnormal or perturbed mode of life. Such body, creature, race or stock is therefore in a state of disease.

The question, What is normal living? is answered through a study of the earliest marine faunas.

Normal living, in the broad sense in which we desire to be understood, means full activity of an unimpaired physiology inclusive of the function of locomotion or mobility. . . . Independent living, freedom of locomotion and range expose the individual to ever new dangers. These the individual must quickly overcome or outwit; otherwise succumb. The choice is quick, imperious and final. . . . Normal living is, in terms of biology, correct living, that is to say, righteous living, and in so far as dependence invades the mode of life whether in organ or individual, such living is unrighteous, disordered and diseased; in better phrase, biologically, is without hope, for such perturbation or disease is beyond voluntary or casual rectification.

Out of right or normal independent living have come all the great triumphs of life; the races of life which, by keeping individual and racial independence, have persistently climbed upward. . . . The giants of the redwood forests are the hoary and venerable obelisks of power shackled beyond redemption; the gardens of flowers are blossoms of a hope never to be attained.

In all of the evolution of endlessly variant life, there has been, however, "a strong minimum, a redeeming minority, of competent upward evolution." It is a certainty that the minorities of geologic life have saved the day for us.

Wise students of nature, in reflecting on this thought, have broken out into exclamations of wonder and amazement at the slender thread of chance by which we who call ourselves men have come to this estate, in a world where for millions of years the temptation to the easier way and the obstacles to independent living were constantly against us.

It would be trite to say that a perfectly adjusted life is an unprogressive one. The adjusted life makes for conservatism and reduces the chances of variation to its lowest terms. . . . Speaking for the moment in higher terms for the individual the adjusted life is likely to carry with it the highest content of happiness. To progress in organic development it is the undeniable foe, but to the conservatism of intellectual and spiritual ideals the undoubted friend.

Clarke finds that 90 per cent. of Cambrian organisms led a life of independence. In subsequent time, dependent life becomes ever greater in individuals and races. Interdependent individual life as expressed in mutual and commensal adaptations is sparingly present in the Ordovician but "not until life had got in full swing did these organic combinations come into existence, even in their simplest commensal expressions." Out of the innocent combination of symbiosis arises parasitism, "an adaptation in which one organism has become helplessly dependent on another for its existence."

If dependence has affected and sealed the fate of one great division of the Kingdom of Life, so that it is and must remain subsidiary to the larger purposes of nature, dependence also has entered upon, invaded and degenerated a very large part, indeed, probably the major part of the other, the animal world. . . . Dependent races of animals have sought or accepted dependence as an easier mode of living, either waiting upon the unconscious forces of Nature, waves and winds, or on the normal activities of other animals. Such dependence has entered in some degree upon all primitive stocks of animal life and from such racial dependence there has been no escape. The lines in the animal world along which links in the chain of advancement have continued unbroken, are but few; the rest have run out into culs-de-sac where all hope is abandoned.

Rescue of dependents is therefore not a part of the scheme of Nature, except through the exercise of intelligence. In Nature's plan of evolution dependents of all sorts are negligible and abandoned to hopelessness, save as gradually developing psychic factors intervene.

These conclusions are so well established that we may rightly look to them for light upon the interpretation of certain tendencies to rest and unrest, conservatism and impulsive change, in human society, and while it may not seem very appropriate to speculate on the further bearing of this theme, it must be said in looking back over the field of organic history, that the value of the product must be in terms of the worth of the type

conserved or broken; that is, worth in the sense of highest attainment in functional grade and in the approach to mentality.

CHARLES SCHUCHERT

SPECIAL ARTICLES

A SIMPLE MICRO-INJECTION APPARATUS MADE OF STEEL

For injection and suction purposes in the field of the compound microscope two very good methods are in existence. One is Barber's[1] mercury pipette. This consists of a glass tube completely filled with mercury. One end is bent into several loops and sealed at the tip. The other end is drawn out into a capillary with a microscopic aperture at its tip. The pipette is held in Barber's pipette holder which is clamped to the stage of the microscope. For injection and suction purposes Barber depends on the expansion and contraction of the mercury by varying the temperature of the loops of the pipette. This method gives excellent results but the pipette is rather difficult to make, it is easily broken and the driving force of the mercury can not be instantly controlled.

A more recent method is that of Taylor's,[2] which also consists of a mercury-filled pipette, but which depends upon a minute plunger to regulate the pressure of the mercury. The plunger method gives the operator a better control of the pressure in the pipette but has the disadvantage of possible leakage around the plunger. This generally occurs after the plunger has been used several times. A great deal of time tends to be wasted in keeping the apparatus in a working condition.

The apparatus described here is very simple to set up and, excepting for the few inches of capillary pipette which can be inserted into the apparatus within a few minutes, it is permanently ready for use. The apparatus depends upon leverage clamps to regulate the mercury pressure which can be controlled at any instant. Consisting entirely of steel and heavy glass it is practically unbreakable, a consideration of great importance for easy manipulation.

As in Barber's and Taylor's instruments, mercury is used to procure the necessary pressure. The apparatus consists of a thin-walled, (.028 inch or less thick), straight, one half inch, steel tube about six inches long (see figure). Into one end of this is sealed an

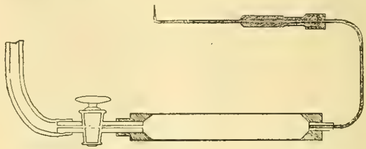

Fig. 1.

accurately fitting steel or glass stopcock. The other end leads into a small steel tube fine enough to be flexible, viz., about 3/32 of an inch in outside diameter. The small tube is bent into a twisted S shape, so that, when at rest, its tip lies on a pipette carrier on the stage of the microscope. The tip of this thin tube is furnished with a screw joint by means of which it may be attached to a hollow steel rod two inches long which carries the glass micro-pipette. The outer end of the stopcock is connected with a rubber tube about four inches long. The steel tube is placed in a special clamping device which is secured to the table beside the microscope. This clamping device consists of three leverage clamps, one of which presses on the steel tube in a direction at right angles to that of the other two.

The apparatus is first filled with clean mercury through a glass funnel inserted into the rubber tube upon which the stopcock is closed. The glass pipette is made according to Barber's method[3] and is sealed with wax into the hollow steel rod.

[1] Barber, M. A., 1911, "A technic for the inoculation of bacteria and other substances into the cavity of the living cell," *Jour. Inf. Dis.*, VIII., 348; 1914, "The pipette method," etc., *The Philip. Jour. Sc.*, Sec. B, Trop. Med., IX., 307.

[2] Taylor, C. V., 1920, "An accurately controllable micropipette," Science, N. S., LI., 617.

[3] See footnote 2, also Chambers, R., 1918, "The microvivisection method," *Biol. Bull.*, XXXIV., 121.

The rod is then screwed to the end of the tube of the injection apparatus by means of the screw point in which is a fiber washer to make the joint tight. The rod is then clamped in a mechanical pipette holder, either that of Barber or one described in an article already printed. The next step is to fill the pipette with mercury. To do this open the stopcock and see that the rubber tubing connected with the stopcock is full of mercury. With a strong clamp close the tubing about four inches from the stopcock. Along this four inches place several screw clamps which, on being screwed down, will produce sufficient pressure to drive mercury almost to the tip of the pipette. The stopcock is then to be securely shut off.

We are now ready for action. Squeezing the metal tubes by one or other of the leverage clamps will drive mercury through a pipette having an aperture of only one micron (.001 mm.) in diameter. Move the pipette by means of the pipette holder till its tip projects into a hanging drop of the solution to be injected. Release pressure on the steel tube and some of the solution will be drawn into the pipette. Now lower the pipette and move the moist chamber till the cell to be injected is brought into view. The pipette is now raised until it punctures the cell. On applying pressure to the steel tube the solution is readily injected. The apparatus may also be used to withdraw materials from the cell.

The apparatus is extraordinarily sensitive. The meniscus of the mercury in the pipette responds instantly to the pressure of the leverage clamps. A comparative estimation of the quantity of injection material used may be made by focusing, first, on the mercury meniscus, then on the tip of the pipette and measuring the distance of the two focal points by means of the fine adjustment screw of the microscope.

A more complete description of this apparatus will shortly be published.

Robert Chambers

Cornell Medical College

ON THE EMISSION AND ABSORPTION OF OXYGEN AND AIR IN THE EXTREME ULTRA-VIOLET

Up to this time very little has been known of the spectrum of oxygen in the region of wave-lengths shorter than λ2000. Some previous investigators were unable to obtain a spectrum in this region. "No lines or bands," says Lyman, "were observed between λ2000 and 1230."[1] Schumann, however, had succeeded in photographing some continuous maxima of which the most refrangible has a wave-length of about 1850 Ångstroms. Moreover, Lyman had observed that the great absorption band of oxygen diminishes in intensity as it approaches λ1230, but he thinks that another absorption band exists "lying in the region shut out by the absorption of fluorite." This preliminary investigation was undertaken, therefore, to test the emission and absorption of oxygen and air in the region of wave-lengths shorter than those transmitted by fluorite.

The apparatus used consisted of a vacuum grating spectrograph, containing a Rowland concave grating of 50 centimeters focus, about 15,000 lines per inch, and a ruled surface of approximately 2 inches. A discharge tube of internal capillary, end-on type and with aluminum electrodes was employed. The tube was also provided with a quartz window for Hg comparison spectrum and opened through a slit directly into the receiver. A method has been developed of making Schumann films, and these were used for the spectrograms. Commercial oxygen, dried with phosphorus pentoxide, filled the receiver and connected discharge tube to a pressure of about 0.4 mm. When the spectrum of air was obtained, this gas was likewise dried and filled the receiver to about the above pressure. The time of exposure varied from 20 minutes to 2 hours for the gas spectra, while an exposure of 3 minutes was found to be sufficient for the Hg-arc comparison spectrum. The apparatus was so arranged that both the first and second orders of the Lyman region

[1] Lyman, "The Spectroscopy of the Extreme Ultra-violet," p. 82.

appeared on the film, the second order being superimposed on the first order comparison spectrum. By the use of the foregoing method, an extensive spectrum was obtained with oxygen in the receiver and is attributed to that gas. A spectrum was also found for air. (See table.)

TABLE

1	I	2	I	3	I	4	I
990.2 }	1–8	1130.0 }	1	916.3	10	1136.4	1
91.7	1–8	68.5	1	1041.8 }	2	1249.4	1
1010.1	2	89.3	1	45.6	2	1216.0	15
36.9	5	1275.7	1	1188.4	2	17.5	1
84.3 }	4			96.0	2	1302.5 } t	10
85.8	4			1224.3	1	5.2	9
1128.4	1			75.3 } [2]	5	6.4	8
34.7	5			77.2	4	1713.9[2]	2
76.2	10			1320.1	4d	30.8[2]	3
80.7	1					43.7[2]	1
84.8	1–10					75.0[2]	2
1200.3	2					93.7	3
15.9	20					1812.3[2]	3
61.6	2					61	3
1302.5 } t	6					80[3]	3
							3
5.2	7					99.9[2]	
6.4	6					1945.6d	3
11.2	1					50.4d	3
24.3	2						
30.0	1						
35.1 }	3						
36.2	3						

Explanation of Symbols of Table: } indicates doublet; } t triplet; } [1] doublet and probably triplet; d diffuse; [2] violet edge of band; [3] continuous maximum.

In almost every instance the wave-lengths given in the table are the averages of two or more plates, hence judging from the consistency of the several measurements they are believed to be accurate to about 0.5 Ångstrom. The first column contains the lines that occur in both air and oxygen. Column 2 gives the lines that were not registered on the films of air spectra, but were on those of the spectrum of oxygen. They are faint. Some of the more intense lines that occur in air only are indicated in column 3; the fainter lines, of which there are about thirty, were omitted from the list. Column 4 is a record of the wave lengths produced in oxygen with direct current discharge. The spectra listed in columns 1, 2 and 3 were obtained with disruptive discharge. In column 4, lines in the Schumann region are included; similar spectra were also present in the cases of disruptive discharge but were omitted from the tabulations.

The other columns are lists of the relative intensities of the wave-lengths in the columns immediately preceding. Where two values of intensity are given in the same column, the first refers to the spectrum with oxygen and the second with air.

It is worthy of note that the line $\lambda 1215.9$ is very strong in the spectrum of oxygen and air even when a direct current was used. This wave length is very near to $\lambda 1215.6$, the fundamental line in the hydrogen spectrum, and probably is that line. This was found to be present in most of the spectra obtained by Millikan in his investigations on the spectra of metals. The transparency of oxygen and air (1340–916 for air and 1336–990 for oxygen) in this region is proved from the fact that these spectrograms were obtained. It is evident that the absorbing layer of gas in these experiments amounted to more than 0.5 mm. at atmospheric pressure, and judging from the intensities of the spectra, these gases are transparent in layers of even much greater thickness. The films of the spectrum of air were badly fogged, and in some cases the entire spectrum appeared reversed. However, since other films of this spectrum were obtained without this reversal, it is believed to be of a chemical nature and due to the corrosive gases formed by the radiation or the discharge. This point will be investigated more thoroughly in the near future. The work of getting the spectra of electrolytic oxygen and pure nitrogen is now on the way, and the thorough search for series lines and for ionization and resonance potential relations is postponed until this new data is available.

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Department of Physics,
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THE AMERICAN CHEMICAL SOCIETY.

(*Continued*)

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

H. N. Holmes, chairman.

S. E. Sheppard, secretary.

Adsorption by precipitates V.: Adsorption during the precipitation of colloids by mixtures of electrolytes: HARRY B. WEISER. The precipitating action of mixtures of two electrolytes is approximately additive if the precipitation value of each is of the same order of magnitude such as frequently obtains when the precipitating ions have the same valence. The precipitating action of mixtures of electrolytes with widely varying precipitating power may be far from additive but under certain conditions may approach an additive relationship. The determining influences are (1) the effect of the presence of each precipitating ion on the adsorption of the other and (2) the magnitude of the stabilizing action of the ion having the same charge as the colloid.

The influence of the concentration of colloids on their precipitation by electrolytes: HARRY B. WEISER AND HENRY O. NICHOLAS. Burton and Bishop (*Jour. Phys. Chem.*, 24, 710 (1920)) state that the precipitating action of univalent ions increases and of trivalent ions decreases with decreasing concentration of colloid while that of divalent ions is almost independent of the colloid concentration. By an extended series of experiments with four different colloids this rule was shown to be far from general. With three of the colloids the precipitation value of all electrolytes decreased as the concentration of the colloid decreased, the effect being least marked with electrolytes having univalent precipitating ions. The determining factors are (1) the change in the amount of adsorption necessary for neutralization, (2) the change in the opportunity for collision of the particles, (3) the influence of the stabilizing ion particularly in the case of electrolytes that precipitate in high concentration.

Intermittent phosphorescence: HARRY B. WEISER. The luminescence of phosphorus is due to the rapid oxidation of phosphorus trioxide to phosphorus pentoxide. The luminescence is continuous only when the trioxide vapors are formed as rapidly as the luminescent reaction proceeds; the luminescence takes place in intermittent explosion waves when the velocity of formation of trioxide is less than the velocity of the explosion wave. The pulsations may be very rapid or may occur at intervals of several hours. The number of luminescent waves in unit time is determined by (1) the temperature, (2) the partial pressure of oxygen, (3) the extent to which the heat of reaction is absorbed by the containing vessel, (4) the presence of "catalytic" vapors.

The ternary system: silver perchlorate-benzene-water: ARTHUR E. HILL. Silver perchlorate is very soluble in water, and moderately soluble in benzene. The system has been studied from the temperature of the ternary entectic (— 58°) up to the boiling points of the pure liquids. There occur four quintuple points, and twelve equilibria. Of most interest is the equilibrium in which three liquid phases are present, which may exist from — 2.2° C. to + 22.3° C. It appears to be the only three-component system showing three liquid layers derived from components in which only one pair (water and benzene) show the formation of two liquid phases.

Hydrated oxalic acid as an analytical standard: ARTHUR E. HILL AND THOMAS M. SMITH. The common drawbacks to the use of hydrated oxalic acid as a standard for oxidimetry and alkalimetry are its retention of included water and its irregularity in combined water due to its distinct vapor tension. These two sources of error should be eliminated by fine grinding, to offer an escape for included water, and by drying to constant weight in an atmosphere in which the aqueous tension is exactly that of the hydrate. We have found that grinding to pass a 100-mesh sieve meets the first requirement. To meet the second, we have dried the compounds over a mixture of hydrated and dehydrated oxalic acid, which is the only drying agent which can be in equilibrium with the compound at all temperatures. The compound can be brought to a constant composition within about three hours, and agrees in its reducing action upon $KMnO_4$ with Bureau of Standards sodium *oxalate* within 0.03 per cent.

Effect of the history of adsorbent on adsorption: R. C. WILEY AND N. E. GORDON. Silica gel was prepared containing various amounts of water of hydration, and shaken with varying concentrations of different salt solutions. It was found that the amount of hydration had some effect on the adsorption of some salts. In most instances the change was very small, but in these cases the analytical method used made the

small changes as certain as where the change was more pronounced.

Adsorption from solution: D. C. Lichtenwalner, A. L. Flenner and N. E. Gordon. Varying concentrated solutions of calcium sulphate, calcium acid phosphate, magnesium sulphate, magnesium acid phosphate, potassium sulphate, and potassium acid phosphate were shaken with alumina hydrogel and iron hydrogel and the maximum adsorption determined by analyzing the solution before and after shaking. The water of hydration was all figured as water of dilution. Both gels show large adsorptions for each radical, and especially was this true in the case of the phosphate radical. The adsorption increased with increase of concentrate. The slow process of establishing equilibrium was also greatly marked.

Effect of hydrogen-ion concentration on adsorption: E. B. Starkey and N. E. Gordon. Hydrated gels of iron and silica were prepared in a very pure condition and shaken with a N/20 solution of KNO_3, K_2SO_4, $KHPO_4$. The hydrogen-ion concentration had been varied by the introduction of sodium hydroxide or hydrochloric acid as the case might allow. The adsorption of each ion was followed by analyzing the solution before and after the shaking and figure the water of hydration as water of dilution. It was found that the adsorption of the metallic ion decreased with an increase of hydrogen-ion concentration, while the nitrate, sulphate, and phosphate radical varied between no change of adsorption as in the case of the nitrate radical to a very noticeable change of adsorption in the case of the phosphate radical.

The sorption of toluene and acetic acid and their mixtures by carbon: A. M. Baker and J. W. McBain. A general method is described for determining the true sorption of both solvent and solute in place of the merely relative values obtained in the usual way for solutions. A maximum value for sorption is obtained which is independent of the absolute temperature; the ratio between the saturation values is that of the molecular weights (acetic acid being present as double molecules); and when solutions are employed, the total amount sorbed still corresponds to a complete monomolecular film in which a certain number of double molecules of acetic acid have replaced a corresponding number of molecules of toluene.

Drop weights of oils in solutions of emulsifying agents: Robert E. Wilson and Allen Abrams.

The preparation and properties of ferric hydroxide gel: Robert E. Wilson, William B. Ross and Leon W. Parsons.

The measurement of the plasticity of clays: Robert E. Wilson and F. P. Hall.

The transitional temperature of the sol and gel forms in gelatin: Robert Herman Bogue. Bingham has shown that viscous liquids can be distinguished from plastic solids by a measurement of the viscosity at varying pressures and an extending of the curves downward till they intersect the axes. The former type intersect at the apex of the viscosity-pressure axes, while the latter type intersect upon the viscosity axis. By applying the principle to gelatin solutions at different temperatures and employing the MacMichael viscosimeter at varying speeds of rotation in place of the capillary type at varying pressures, it is found that the gelatine follows the law for a viscous liquid at temperatures above 33 degrees C., while at lower temperatures it follows the law for a plastic solid.

On the swelling and gelation of gelatin: Robert Herman Bogue. Gelatine sols were treated with solutions of the silicates of sodium in which the $Na_2O:SiO_2$ ratio varied regularly from 1:4 to 1:1. The swelling, viscosity, alcohol number, and P_H values were determined. The data indicate that the effects resulting from such additions are due in all cases to changes in the P_H rather than to any other influence of the silicate. Gelation appears to be dependent upon the tendency of the substance to become solvated, the volume occupied by unit weight of dispersed phase being the determined factor. When this volume is very small or very large, the jelly consistency will be low, and at intermediate values of volume per unit weight the jelly consistency will reach its maximum.

Plasticity of colloids: Eugene C. Bingham.

The fluidity-pressure curves of gelatine solutions: S. E. Sheppard, Felix A. Elliott and Harry D. Gideouse. Gelatine solutions were studied whose concentration varied from 1 per cent. to 8 per cent. at temperatures of 25°, 28° and 30° C. The fluidities were measured with an Ostwald type viscometer under pressures up to 900 mm. water. Ordinary, de-ashed and a mixture of de-ashed and autoclaved de-ashed gelatines were used. All measurable solutions showed little evidence of plastic flow, the curves being linear and approximately intersecting at a common point.

The method of preparing the solution was shown to influence the slope of the curves.

The action of dilute chloride solutions upon silver chloride: GEO. SHANNON FORBES AND H. ISABELLE COLE.

The potentials at the junctions of chloride solution: D. A. MACINNES AND Y. L. YEH. E.m.f. measurements were made on cells of the type:

$$Ag/AgCl + MCl \text{ L } M'Cl = AgCl/Ag$$

(in which M and M′ are the alkali metals and hydrogen) using a flowing junction similar to that developed by Lamb and Larson. With widely varying rates of flow the potentials were constant to $\pm$ 0.02 mv. for indefinite periods. With equal concentrations on both sides of the junction and assuming the chloride ion activity to be the same in all the solutions the measured e.m.f. is that of the liquid junction only. The results may be expressed by a simple additive relation in the few cases in which the formula of Lewis and Sargent does not hold.

Electrometric titration of ortho-phosphoric acid: E. T. OAKES AND HENRY M. SALISBURY. New curves for ortho-phosphoric acid titrated with sodium hydroxide and sodium carbonate are shown. These curves are plotted to show observed e.m.f. values as well as P_H values. Condenser method, and saturated calomel cell are used for measuring e.m.f. Technic of titrations, method of calculating results and sources of error are discussed briefly. Curves obtained by titrating phosphoric acid with sodium hydroxide, and sodium hydroxide with phosphoric acid are not mirror images. The second end point of phosphoric acid required more than twice as much alkali as the first. Curves obtained by titrating phosphoric acid with sodium carbonate, and sodium carbonate with phosphoric acid are vastly different. Equations conforming to these curves differ from those commonly accepted.

Oxidation-reduction potentials of certain indophenols and thiazine dyes: BARNETT COHEN AND W. MANSFIELD CLARK. A series of indophenols consisting of the condensation products of para-amino phenol with phenol, o-cresol, m-cresol, o-chlorophenol, guaiacol, thymol and carvacrol were synthesized. The potentials of mixtures of each of these with its reduction product were measured with a gold electrode at different P_H values. It is shown that the same general relations hold that were found by Clark in the study of methylene blue and indigo sulfonate, the potentials being a function of both the ratio of oxidation product to reduction product and of the hydrogen-ion concentration. The effect of substitutions in changing the characteristic potentials is noted. Previous work with methylene blue has been extended to other thiazines. Characteristic constants for thionine, gentianine, toluidine blue o, thiocarmine R, methylene green G and new methylene blue N have been established.

Oxidation-reduction potentials of sulfonated indigos: M. X. SULLIVAN AND W. MANSFIELD CLARK. A trisulfonate and tetrasulfonate were found to have identical characteristic potentials when each was in definite ratio to its respective reduction product. These potentials are distinctly more positive than those of mono- and disulfonates. The potentials of the mono- and disulfonates are approximately the same but more refined measurements will have to be made to distinguish them.

A series of oxidation-reduction indicators: W. MANSFIELD CLARK AND H. F. ZOLLER. It is shown that certain dyes are as susceptible to precise electrode study as are certain inorganic oxidation-reduction combinations. The great importance of hydrogen-ion concentration is emphasized. The potentials for each dye can be reduced to a characteristic value from which there may be calculated the hypothetical hydrogen pressures in equilibrium with the oxidation-reduction products. These values are used in the form log $(1/H_2)$ to which is given the symbol rH. Plotting the equilibria on the rH scale gives a picture of oxidation reduction indicators comparable with that of the acid base indicators plotted on the P_H scale. The following oxidation-reduction indicators were shown plotted on the rH scale: guaiacol indophenol, o-cresol indophenol, o-chloro indophenol, methylene green, thionine, methylene blue, indigo tetrasulfonate, new methylene blue, indigo disulfonate, neutral red and safranine. These constitute a series from rH 21.7, at the more oxidative end to rH 2.8 at the more reductive end of the scale.

Selenium galvanometric colorimeter: ALEXANDER LOWY AND OSWALD BLACKWOOD.

A submerged floating equilibrium bob that adjusts its weight to the density of the liquid in which it is placed: C. W. FOULK. This is a modification of the Richards floating equilibrium bob so that it can be used for the determination of the density of liquids over a considerable range. Preliminary experiments show that measurements of density can be made with it with an accuracy

of one or two in the fifth decimal place and probably in the sixth place, and that a given bob as modified will cover a range of about two decimal places, that is, with one instrument, for example, densities ranging from 1.00001 to 1.00010 could be read. The modification consists in attaching a light chain to the bob which is a fish-shaped, hollow glass, or silica bulb. It is evident that if the weight of such a bob (a certain amount of ballast is usually necessary) is approximately that of an equal volume of the liquid in which it is placed, it will assume a position of equilibrium between the surface of the liquid and the bottom of the containing vessel, the equilibrium being brought about by the chain suspended from its lower end. As the bob rises it lifts the chain link by link off the bottom of the vessel till the added weight counteracts the upward tendency and of course the reverse takes place if the bob tends to sink. A practical instrument utilizing this principle is made by having the bob in a tube open at both ends and with one end of the chain attached to the lower end of the tube, so that it hangs in a loop (catenary curve) between this point of support and the bob. The density of a liquid in which this instrument is placed can be determined by noting the position which the bob takes with respect to a scale on the tube. There are a number of interesting variations of the instrument that can not be given in a brief abstract.

The comparative value of different specimens of iodine for chemical measurements: C. W. Foulk and Samuel Morris. Iodine was purified in various ways as described in the text-books of analytical chemistry and these preparations were then compared through the medium of a sodium thiosulphate solution with a specimen of iodine that had been purified as if for an atomic weight determination. Several new modifications of apparatus for purifying and drying iodine were also devised. The general conclusion drawn from the experiments was that the so-called "analytical" iodine is remarkably pure. Doubt, however, is thrown on the use of a sulphuric acid desiccator as a method of drying iodine when the water it contains had been entrained through the solidification of the iodine in the presence of liquid water.

Variation of grain size in photographic emulsions in relation to photochemical and photographic properties: E. P. Wightman, A. P. H. Trivelli and S. E. Sheppard.

The physico-chemical properties of strong and weak flours III. Viscosity as a measure of hydration capacity and the relation of the hydrogen-ion concentration to imbibition in the different acids: Ross Aiken Gortner and Paul Francis Sharp. In continuation of the work reported at the Chicago meeting of the Society, the authors have applied the use of the viscosimeter to the study of hydration of the emulsoid colloids present in wheat flour. Instead of using the washed out gluten as in previous work a 20 per cent. suspension of the entire flour was used in the present study. The results indicate (1) that the viscosimeter affords an accurate and rapid means of measuring imbibition, (2) the form of the viscosity curves is identical with that of the imbibitional curves obtained previously by weighing gluten discs, (3) "strong" flours give greater viscosity values than do weak flours at the corresponding concentration of acid calculated on either normality or hydrogen-ion concentration basis, (4) when the viscosity is plotted against hydrogen-ion concentration instead of against normality of acid a radically different form of curve results, with a maximum viscosity at about $P_H = 3.00$, (5) the same value for maximum viscosity is not reached by all acids at the same hydrogen-ion concentration, (6) the order of the acids as influencing imbibition (lyotropic series) is not the same for all of the flours studied.

An interesting colloid gel: Ross Aiken Gortner and Walter F. Hoffman. A rigid gel can be prepared from di benzoyl 1. cystine containing as little as 0.15 per cent. of the compound. Viewed by dark field illumination this is apparently a crystal gel. It is suggested that this material may assist in studies regarding gel structure for it can be easily prepared in pure cystalline form and is consequently not affected by previous history as is gelatin, agar, etc.

Are electrolytes completely ionized at infinite dilution? Harold A. Fales and Harold E. Robertson. Measurements made on hydrochloric, acetic, sulphuric and phosphoric acids up to a dilution of three million liters per mol, by the electromotive force method using the ballistic galvanometer, show that the thermodynamic ionization passes through a minimum and approaches zero with increasing dilution. It seems that it is not until a dilution of one thousand liters per mol is reached that the thermodynamic concentration of hydrogen ion becomes equal to the ionic concentration.

Charles L. Parsons,
Secretary

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THE PRESENT SITUATION IN FORESTRY, WITH SPECIAL REFERENCE TO STATE FORESTRY[1]

No nation can prosper or even exist in comfort without wood, without a considerable supply of relatively inexpensive timber. Three years ago our per capita annual consumption of wood was about 300 board feet, exclusive of large quantities used for fuel, paper and a multitude of other purposes. It is extremely difficult for our minds to picture what this means in total volume or amount when multiplied by 110 million, our present population. Each year we remove from our forests or destroy through forest fires about 56 billion board feet of timber large enough to saw into lumber. This almost incomprehensible amount of wood disappears from our forests every year. Much of it we need and use, and can not very well get along without. On the other hand much of it is destroyed by fire. The latter is not only a great immediate economic loss and waste, but also an encroachment on supplies that will be very much needed in the immediate future.

As a nation we have grown to our present stature on a lavish diet of wood. We use more wood than any other nation on earth. Our industries would stop, our very civilization stagnate were we suddenly deprived of our wood supply. Wood the world over is a basic resource. It is almost the first resource to be exploited and utilized in the development of a new country. Moreover, it is the resource that makes possible the utilization of other resources. There is scarcely an industry that can prosper without wood. Agriculture, transportation and commerce as we know them to-day are inconceivable without wood. All of us are daily in contact with wood wrought into some form for our comfort or necessity. From

[1] An address delivered in the School of Citizenship, Yale University, Wednesday, October 26.

morning until night wood in one or another of the diverse forms into which man has shaped it is influencing your life and mine.

If we trace the progress of industrial development in the civilized nations of the earth we are impressed by the apparent fact that:

1. Industrial development proceeds faster in countries when domestic or imported wood is available in considerable quantities.

2. Industrial development becomes arrested when available wood supplies are reduced below the essential needs of industry.

China at one time was well wooded. Prior to the exhaustion of her timber supplies she reached a stage in civilization and economic development beyond that of most other nations. She exhausted her forests centuries ago and has been without wood adequate for her essential needs for many generations. Historians have assigned many reasons for the early arrest in economic progress by the Chinese. It appears, however, that the progressive destruction of her forests far below the point of essential wood needs made the development of other industries impossible or extremely difficult.

Japan, on the other hand, although surpassed in civilization and industry by China during the long period while Chinese wood was available in quantity, has never exhausted her forests and now has wood in abundance. There is every reason to believe if Japan had followed China's example and had devastated and exhausted her forests and made no provision for regrowth, we would hear little of Japan to-day as a world power. Greece, once powerful and prosperous, fell from her high estate centuries ago. She swept the forests from her hills and mountains in attaining her power and in building her civilization and did not make provision for regrowth. She destroyed her forests, she neglected regrowth and lost her place in the sun. She is still without adequate wood for her essential needs. Switzerland, a small nation of mountains and hills, though poor in soil and most other resources upon which the strength of a nation depends, has retained her forests. She still has wood, a basic resource. She is prosperous and forward moving.

The republic of Switzerland, only a little larger than the state of Connecticut, has three million people tilling less than 20 per cent. of the land. Some of her forests were organized as early as 853 A.D. They have been continuously under timber production for more than 1000 years and are more intensively managed and more productive to-day than ever before. The government assumes control over all absolute forest land and the following three requisites are a part of the forest laws:

(*a*) The forests must not be divided in area or broken up by sales.

(*b*) The volume of the cut must be prescribed and the fellings must follow a plan which maintains a growing stock of trees.

(*c*) All areas cut must be promptly restocked.

The forest laws of Switzerland declare that her forest area must not be diminished but the private owner can demand that his forest be bought by the public if he feels unable to manage it under laws which insure its perpetuation. These laws have for their object the maintaining of the forest in area and with stocked stands of growing trees.

England, though a leader among nations in economic and industrial development, has reached her place of eminence in world affairs without maintaining an adequate domestic supply of wood. Great Britain, an island empire, the first sea power of the world, has been able to meet the need of her industries for wood by bringing it from the four ends of the earth. The recent war, however, has shown her the necessity for domestic wood resources and she is now expending millions of pounds in reforestation.

America was blessed with abundance of wood when settlement began early in the seventeenth century. More than half of what is now the United States was covered with virgin forests, composed of a great variety of species, many of which are unexcelled for lumber and other essential products. We have been called a nation of home builders; we have built our homes out of the forest and we have kept them warm with wood cut in the forest. We have been more lavish in the use of wood than any other nation. We have used and destroyed the

wood at hand and thought little of the future. To-day 110 million people in the United States are using wood just as lavishly, just as wastefully as when our country was young. As a nation we have been unable to think in terms of possible timber exhaustion. Three or more centuries of forest devastation, of forest destruction, have given us the habit of thinking of the forest as inexhaustible.

Let us go into the woods and see what we can find. It must be clear to all of us that no matter how large an area of forest land this country holds within her borders, if there are no trees growing thereon we can not look forward to getting wood to build our homes and supply our industries. We must have foresight to see that regrowth or young stands of timber of acceptable species must reclothe forest land after the removal of old timber through lumbering, fire or other causes. Future timber supply to meet the essential needs of this country depends upon one thing and one thing only, namely, adequate regrowth. Somehow, or in some way, this regrowth must be attained.

Since settlement began we have been getting our wood for the most part from virgin forests, namely, from woods that were thousands of years in developing and were never disturbed by man. As a nation we have cut and otherwise destroyed the virgin forests so rapidly, out of our original 822 million acres we now have left only 137 million acres and these for the most part are in the more inaccessible parts of the country, chiefly in the far West. For all this the remnant of our virgin stands are now yielding three fourths of all the saw timber that we consume. At our present rate of cutting and present rate of destruction by fire, it is certain the remainder of our virgin timber will be practically all gone within the life time of people now living. At present we obtain but one fourth of our timber needs from forest land previously cut over or from stands that have grown since the removal of the virgin crop. It must be clear to all of us that with the passage of time more and more of our timber needs must be met from trees grown on forest land that has been previously cut over. It must also be appreciated that in the not distant future all our wood must come from such land because there will be no virgin forest left.

Prohibiting cutting in the remnant of our virgin forests will not give us an adequate future timber supply. We should not be critical of the cutting of virgin timber or for that matter of the cutting of merchantable second growth timber. The wood is needed and is a basic resource in our national progress and industrial development. We should be critical that regrowth, in the form of fully stocked stands of desirable species, does not follow the removal of the old stand by logging, by fire or by any other cause whatsoever, when the removal is from forest land, that is, land better suited for the growth of timber than for other economic uses.

As a nation we have been so remiss in providing for regrowth, for new crops of timber of acceptable species, to take the place of the old, we are certain to suffer a severe timber shortage as the remnant of our virgin timber disappears and we are forced to turn to second growth for a constantly and rapidly increasing percentage of the wood supplies essential for our prosperity and well being.

About 463 million acres of the land area of the United States is classed as forest at the present time, but of this vast area 326 million acres have been culled of their best timber, cut over or burned. For the most part these 326 million acres have been left to chance restocking and only a comparatively small percentage is fully stocked with desirable species. Nearly all of this vast area now bears a more or less fragmentary growth, often of inferior species. On a fourth of the entire area there is no forest growth whatsoever and the land is idle.

What can we expect in the way of future timber supplies from our culled, cut-over and burned forest areas? This is a very important economic question at the present time. Please remember 326 million acres of our present area of forest land culled, cut over or burned, and only 137 million acres of virgin forest remaining, all of which will soon be gone.

Assuming that our area of forest land re-

mains as it is to-day, namely, at 463 million acres, and that we exercise no more foresight in harvesting the remainder of our virgin forest than we have in the past, what can we expect in annual growth when our virgin timber is gone, to supply this great nation with wood? The United States Forest Service estimates the present annual growth on our 326 million acres of burned and exploited forest at approximately 6 billion cubic feet. Assuming that the annual growth on exploited forest land will remain as it is at the present, after we have exploited the remainder of our virgin forests, the total 463 million acres of forest property in the United States will produce an annual growth of approximately 7 1/2 billion cubic feet. This is all that will be produced by growth each year unless we radically change our present forest policy and conscientiously plan for regrowth on a vast scale.

It is a very serious economic situation that we are now using up our forest capital more than four times as fast as we are producing it. In other words the annual growth in our forests is now approximately 6 billion cubic feet while the annual removal of wood from our forests by lumbering, fire and other causes, is over 26 billion cubic feet. We are cutting into our forest capital—the reserve supply, largely in our virgin forests—more than four times as fast as we are growing wood.

It must be evident to all that we can not go on using each year four times as much wood as we grow in a year and do this indefinitely. It must also be evident that our future supply of timber will not be assured until the annual growth of wood on our 463 million acres of forest land is at least as much as what we annually consume.

Without forest management and without serious attention given to regrowth, we grow each year less than one fourth as much wood as we use, but were all our 463 million acres of forest land fully stocked and in different age classes, there is ample evidence to show that the annual growth would be raised to approximately 28 billion cubic feet. In other words, it is possible to produce, through increased growth on our present area of forest property, more than four times as much wood as is now grown. An annual growth of 28 billion cubic feet of wood in the forests of the United States is a goal toward which we should push. It will take a century to place all our forest property under management and to fully stock all our 463 million acres of forest land with acceptable species. An annual growth of 28 billion cubic feet, however, can not be attained until this is done.

Were all our forest land under management and fully stocked, would we be able to use advantageously the amount of timber each year represented in the possible annual growth of 28 billion cubic feet? We are now using and destroying annually approximately 26 billion cubic feet of wood; only a little less than can be grown on our entire area of 463 million acres were it all under a system of management as excellent as that of Central Europe.

Although there appears to be no inherent reason why this nation can not grow yearly as much wood as we now consume, it will not be done and moreover it can not be done without public approval and public support. The raising of the present annual growth in our forests from 6 billion cubic feet to a possible annual growth of 28 billion cubic feet is necessary if we are to be adequately supplied with wood fifty years hence.

As conditions are at present we Americans are faced with the essential fact that we are not only destroying our forest supplies more than four times as fast as we are growing them, but what is of more far-reaching importance we are, through lack of forest organization and management, rapidly using up the productive capacity of our forest lands. Not only is there less and less wood grown each year but more and more forest soil is destroyed each year beyond the power of immediate recovery for the production of wood crops. The investigations of the United States Forest Service show that already 81 million acres, out of our 463 million acres of forest property have been so completely

denuded, they are now idle, and with no immediate prospects of regrowth. This vast area scattered through many states is of no more immediate value to the nation or to the owners than it would be were it in the heart of the Sahara Desert.

The destruction of our timber through lumbering and fires without providing for regrowth and the destruction of the timber-producing power of vast areas of land valuable for no other purpose would not be so important from the standpoint of our future industrial development were it possible to obtain needed wood from beyond our own borders. Can we look to other countries for the enormous amount of wood needed if we permit our forests to fail us through our neglect to obtain regrowth? We can not. Mexico has no more lumber than she needs for her own use. Canada has already made it plain that we can not look to her for lumber supplies in large quantity. The old world requires all the available wood in her forests and tropical America, although with vast resources of hardwoods, has comparatively little that is suited to the needs of the American people. In short, as time goes on we must grow our own wood or go without. Furthermore, we must increase the growing of timber on a vast scale during the next fifty years while we still have virgin forests that remain uncut.

A program for the growing of timber on an adequate scale for our future needs must include:

First, organized fire protection and prevention that will eliminate present losses to young and old stands from forest fires.

Second, the prevention of owners of commercial forests now uncut from destroying, through destructive lumbering, the power of their lands to keep on growing trees.

Third, the reforestation of those parts of our forest area of 463 million acres that have become more or less completely denuded and are now without regrowth or are inadequately stocked.

Fourth, the improvement of existing regrowth and that to be attained in the future by systematic silvicultural operations.

Please remember all of these must be put into operation and continued until all our forest property is subject to them. Even if we begin now, a hundred years, at least, will be required, and the expenditure of vast sums of money, if we finally reach our goal and increase our annual growth from 6 billion cubic feet of wood to 28 billion cubic feet, which measured by present consumption appears essential for our future needs.

Bringing this important question of inadequate forest growth and denuded and imperfectly stocked forest land nearer home, let us look at the state of Connecticut. Any one of a dozen eastern and southern states might be taken as well. Connecticut was originally completely covered with hardwood and softwood forests. From the time of settlement until toward the middle of the last century the state produced more lumber than she used and some was shipped abroad or exported to other states. Since then she has been unable to supply wood for her own essential needs. Constantly increasing quantities are yearly imported from other states and from other countries.

Connecticut was early settled and the land was gradually cleared for agricultural use. Farmers settled on areas of primeval woods and started to carve farms out of the wilderness. The land embraced in the entire state of Connecticut early passed to the ownership of private citizens. The farms were the year-long homes of the people who owned them. Roughly they were composed of agricultural land and forest land. Early in the last century the forest had been cleared from approximately three fourths of the state and the land taken for agriculture and grazing, also a considerable part of the remaining one fourth still bearing forest had been culled of its best timber, or more or less completely cut over. The last remnant of the virgin forest disappeared early in the present century.

Throughout Connecticut, as in most other eastern states, acceptable farm land is interspersed with forest land, that is, with land

that it is unprofitable to attempt to cultivate. The average farm therefore contains both agricultural land and forest land. In the poorer regions of the state, as in parts of Litchfield and Middlesex counties, the larger percentage of the farms is forest land while in Hartford County the larger percentage is agricultural land. Although three quarters of a century or more ago, three fourths of the land of Connecticut had been cleared for agriculture and grazing, much of this cleared land has since been abandoned as fields and pastures and left to return to forest. To-day almost one half of the entire area of the state is classed as forest and the area in productive agriculture has been gradually decreasing for a half century. Why has the area of Connecticut soil used for the production of agricultural crops so persistently and so rapidly fallen off and why has so much land formerly cultivated been permitted to revert to forest?

During the long period of extension of Connecticut agriculture and reduction of the forested areas, the farmers not only tilled their fields in summer, but they worked in the woods in winter. Only a part of their sustenance and profit was derived from their cultivated fields; a considerable part came from the woodland part of their farms. So long as it was possible to find profitable employment during the long winter in their own woodlots, a comfortable living for themselves and families could be derived from their farms, but as soon as the woodlots had been culled of all the best timber and nothing left but cheap fuel wood, it was no longer possible to obtain year-long employment and a comfortable living from the fields alone. For fifty years abandoned Connecticut farms have been in evidence in every county in the state. This abandonment is due to economic pressure forced through the exhaustion and often almost the complete destruction of the productive capacity of the forest land, thus impelling the cleared land alone to support a permanent population which in many cases has been economically impossible.

When the forests of Connecticut were still producing timber in abundance, and agricultural extension had claimed the maximum of Connecticut land, land utilization was at its height. It is a long way from our climax of land utilization in this state of fifty or more years ago to what we find today. Not only have we greatly reduced the area in productive agriculture, but our woods, although increasing in area, have almost completely lost their capacity for yielding timber of large sizes and of high value. They are for the most part stands of sprouts that have been repeatedly culled and cut over until little but inferior fuel wood remains. Although the state now boasts of nearly one half of her total area as forest, its growing capacity is so low and the quality and kinds of timber so inferior, we are forced to send out of the state for 83 per cent. of all saw timber we consume and upon which we yearly pay four to five million dollars in freight alone. Although the forests of the state produce little timber of high grade and of desirable species which command high prices, our woods are filled with inferior species, and low-grade wood chiefly useful for fuel which commands a stumpage price but little higher than that of a half century ago.

While the forests of the state were productive, industries using wood as a raw product were widely distributed through our villages and towns. Every village had its cooper and its wheelwright. Barrels, wagons, tubs, ox-yokes, and all the various articles made from wood and used in a given community, were locally made from home-grown wood in that community.

Wood from local forests helped to support community life and nearby forests provided employment to supplement farm work. Large areas in this state as well as in most other states can not sustain profitable agriculture unless the intermingled areas of forest land are made productive. The development of agriculture and the development of forestry must go forward together wherever part of the land is unsuited for farm crops.

In my opinion an increased population on the land in this state can not be attained and

a more complete land utilization undertaken without employing modern forestry methods in improving forest land which, as you remember, occupies nearly one half of the entire state. If the present forest area of this state were fully stocked and in various age classes, we could, in a very short time, vastly increase our agricultural production, as it would make possible permanent homes on areas that, without nearby woods to afford employment to supplement farm work, is economically impossible.

I sincerely hope that I have been able to impress you with the serious situation which now confronts the American people as to adequate future supplies and for the need of a radical change in forest policy which will make regrowth possible on an extensive scale while we still have virgin supplies for our immediate needs. I sincerely hope that I have been able to impress you with the seriousness of present land problems in states like Connecticut whose agriculture has declined with the removal of the forest.

If you accept my thesis that forestry practise must be established on all of our 463 million acres of forest land, if we are to grow as much wood each year as we will need for the best development of our industrial life, you may well ask how can it be attained. It can never be attained if left to individual effort. Its attainment is primarily a function of government. The forest history of the old world clearly proves that forests are over cut and otherwise destroyed when their control and management are left entirely to private land owners. No nation can perpetuate her forests through wise use unless they are publicly owned or publicly controlled. This nation with four fifths of her forests privately owned, can not possibly attain the regrowth essential in forest renewal unless the public exercise mandatory control and demand of the private land owner that regrowth must follow as a natural consequence of forest exploitation. As a people we must appreciate that our continued prosperity is dependent upon the conservation and wise use of our 463 million acres of forest land. We must also appreciate that the forests thereon are threatened with extinction by the methods under which much of the forest is now handled. We must work for a forest policy which embodies reasonable public regulation of operations in all forests, both public and private. We must work for adequate fire protection, for reforestation, for silvicultural practise and for further acquisition of national, state and communal forests, and all these on a scale which will with certainty insure a future supply of wood to meet the needs of the nation.

The nation, the state, lesser governmental units and the private owners of forest land must cooperate and work together if adequate regrowth to meet the needs of the country is attained. There is need for national legislation and large national appropriations to stimulate cooperation with the states, and provide for fire protection, reforestation, investigation and silvicultural practise. There is need for state legislation which requires of the private owner of forest land that it be kept fully stocked with growing timber and of the state that through tax adjustment, fire protection, and in other ways it make regrowth possible of execution without becoming a financial loss to the private owner. There is need for state legislation providing for local forestry boards comprised of foresters, timber-land owners and timber users to interpret the degree of stocking in their particular locality which will meet the requirements of the law.

As it is in all states to-day, forest property may be taxed for its full sale value. The owner of a growing crop of timber may be taxed fifty times on the crop before ready for harvest and without deriving a single dollar from it until cut. If taxed each year at its full sale value he may pay out more in taxes during the growth of the crop than its entire sale value when cut. This outgrown method of forest taxation must be changed.

Forest crops are inflammable and subject to serious loss by fire. So long as the fire hazard is as great as it is at the present time there is little incentive for private owners of forest land to establish stocked stands of young timber and carry them forward to

maturity. In my judgment it is clearly the duty of the state to adjust taxation on growing stands of timber, provide adequate protection against fire and other destructive agents, instruct the public in silvicultural methods and encourage reforestation by providing planting stock. In return for this assistance by the public, forest land must by law be subject to public regulation which will insure regrowth of acceptable species. Furthermore this public regulation must be in the hands of local boards whose function it is to interpret the requirements of the law in their particular locality.

Constructive state forest legislation is only in its beginning. It is your duty and mine to assist in every way we can in making regrowth possible. First, as American citizens and voters we should work for increased publicly owned forests by the nation, by states, and by local communities. Second, as American citizens and voters we should work for the reasonable public regulation of all forest lands, based upon a system of cooperation between the public and the private owner that will make regrowth possible without, in the long run, entailing financial loss upon the owner. Third, as American citizens and voters we should work for more liberal financial support of the entire forestry movement by both the nation and the state.

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OCCURRENCE OF PLEISTOCENE VERTEBRATES IN AN ASPHALT DEPOSIT NEAR McKITTRICK, CALIFORNIA

Pleistocene mammalian remains from asphalt deposits located along the southwestern border of the Great Valley of California have been known since 1865, when Joseph Leidy reported the occurrence of two horse teeth from near Buena Vista Lake and referred the specimens to *Equus occidentalis*. Further remains of this species from the region of Buena Vista Lake were described and figured by Leidy[1] in 1873. Thirty years later J. C. Merriam[2] described a fragmentary lower jaw of the dire wolf, *Ænocyon dirus*, that apparently came from an asphalt bed in Tulare County, California.

The construction of the Taft-McKittrick highway in the petroleum producing belt southwest of Bakersfield has brought to light a fossiliferous bed of asphalt on the southern outskirts of the town of McKittrick. The deposit is apparently located in a narrow zone of asphaltic material shown on the geologic maps[3] of the McKittrick oil region as traversing the foothill region immediately southwest of McKittrick. As mapped by Arnold and Johnson this brea belt is associated areally with Pliocene and Miocene marine beds and is found also in contact with the alluvium of McKittrick Valley.

The occurrence of bones in asphalt near McKittrick was known for many years to the Department of Palæontology of the University of California. Recently John B. Stevens explored the deposit and secured a number of specimens that were kindly presented to the University. During the past summer a field party from the Museum of Palæontology with cooperation and support of the Carnegie Institution of Washington, commenced excavations and made additional collections. Grateful acknowledgment should be made to the Midway Royal Oil Company for permission to excavate and for valuable assistance rendered during the progress of the work.

In the brea deposit near McKittrick a surface stratum of hardened asphaltic material reaches in places a thickness of several feet. This layer contains numerous remains of birds and mammals, apparently represent-

1 Leidy, J., *Proc. Acad. Nat. Sci. Phila.*, 1865, p. 94; Rept. U. S. Geol. Surv. Terr., pp. 242–244, pl. 33, fig. 1, 1873.

2 Merriam, J. C., Univ. Calif. Publ. Bull. Dept. Geol., Vol. 3, pp. 288–289, pl. 30, fig. 2, 1903.

3 Arnold, R., and Johnson, H. R., "Preliminary report on the McKittrick-Sunset Oil Region, Kern and San Luis Obispo Counties, California," pl. 1, U. S. Geol. Surv. Bull. 406, 1910; Pack, R. W., "The Sunset-Midway Oil Field, California, Part I., Geology and Oil Resources," pl. 2, U. S. Geol. Surv. Prof. Paper 116, 1920.

ing the Recent fauna, and overlies the deposit in which Pleistocene vertebrates are found. In excavating the older bed dense accumulations of mammalian remains were encountered. This deposit is in general comparable to these occurring at Rancho La Brea. The exhumed material was, however, not so well preserved as that from the asphalt bed near Los Angeles. This seems due, in a measure, to a prevailing earthy matrix showing somewhat less impregnation by petroleum than in the Rancho La Brea beds.

A small collection of bird remains from the McKittrick deposit was submitted to Dr. L. H. Miller for examination. A preliminary statement has been kindly given by Dr. Miller as follows:

1. Of the ten species thus far determined, six are aquatic or semi-aquatic in habit. With more careful examination to determine exact identity of ducks and waders, this proportion will be increased. Quite the reverse is true of the Rancho La Brea beds.

2. The golden eagle (*Aquila chrysaëtos*) is the most abundant species of land bird. One hawk (*Circus*), one caracara (*Polyborus*), and two falcons (*Falco sparverius* and *F.* near *fuscocerulescens*) are the only other raptors. No owls or vultures appear in the collection.

3. *Parapavo* is not represented. A single quail bone represents the great group of Gallinæ.

4. Shore birds (Limicolæ), so rare in the Rancho La Brea beds, are very abundant here. More specimens of this group are present in the collection of 100 specimens from McKittrick than in all the 50,000 examined from Rancho La Brea.

5. So far as examined there appear no extinct or extra-limital species not found at Rancho La Brea. On the other hand *Teratornis, Parapavo,* the great list of condors, vultures, eagles, old world vultures, and owls are thus far lacking.

6. The caracara, the indeterminate falcon, and the two storks, *Ciconia* and *Jabiru,* give the same suggestion of semitropic climate as in the case of Rancho La Brea.

Following is a provisional list of the Pleistocene mammalian fauna known from the McKittrick locality:

Ænocyon dirus (Leidy)
Canis, near *ochropus* Esch.
Felis atrox Leidy
Felis, near *daggetti* Merriam
Arctotherium, near *simum* Cope
Mylodon, sp.
Equus occidentalis Leidy
Antilocapra?, sp.
Bison, sp.
Camel, slender limbed form
Mastodon, sp.

Several of the mammalian species listed above are known from Rancho La Brea. The dire wolf (*Ænocyon dirus*), the great lion (*Felis atrox*) and the horse (*Equus occidentalis*) also occur in the asphalt beds near Los Angeles. Machaerodont cats have not been recognized at the McKittrick locality. The bear (*Arctotherium*) and the ground sloth (*Mylodon*) occur in both deposits, although the forms represented at McKittrick may be specifically separable from the types found at Rancho La Brea. A camel with slender limbs is certainly distinct from the large *Camelops hesternus* found at Rancho La Brea.

Further collecting at the McKittrick locality will bring out the relationship between this assemblage and the Rancho La Brea fauna. The contrasting features that are recognized at present may result from a geographic separation of the two asphalt deposits. It is probable that the environmental conditions prevailing in the southern portion of the Great Valley of California during the Pleistocene were somewhat unlike those existing in the vicinity of Rancho La Brea. On the other hand, it may be that the faunal differences are to be interpreted as indicating separate stages of the Pleistocene.

John C. Merriam,
Chester Stock

SPECIAL OIL-IMMERSION OBJECTIVES FOR DARK-FIELD MICROSCOPY

Dark-field microscopy was introduced by Joseph Jackson Lister in 1830, and by the Rev. J. B. Reade in 1837. The optical principles were clearly enunciated by F. H. Wenham in 1850–1856, and apparatus substantially as now employed was made and described by him for use with high powers.

In 1877 Dr. James Edmunds constructed special paraboloid condensers for dark-field work with high powers, and insisted upon the necessity of a homogeneous contact of the top of the condenser and the lower face of the microscopic slide, and that the slide should have a thickness corresponding to the focus of the condenser. He recommended this means of study for the body fluids like blood, etc., and for the investigation of living bacteria, whose appearance and actions were described by him in a most striking and picturesque manner.

This information was published in some of the most important and widely distributed English publications (*Transactions of the Royal Society,* 1830, *Trans. Micr. Soc. of London,* and *Quart. Jour. Micr. Science,* 1850–1856; *Jour. Quek. Micr. Club,* and *Month. Micr. Jour.,* 1877; Quekett's "Treatise on the Microscope," 1848–1855, and Carpenter's "The Microscope and its Revelations," 1856).

In spite of this wide publicity the dark-field microscope was used very little either in biology or in medicine. After the discovery in 1905 of the microbe of syphilis, and that it could be demonstrated in the living state with the dark-field microscope, this method of investigation became of vital importance to medical men; and that importance has increased rather than diminished in recent years.

It seems to the writer that it is of equal if not greater importance to the biologist, the physiologist, and the clinician for the examining of the body fluids in health and disease and in the study of living micro-organisms, for it brings out with the greatest clearness structures and details of structure invisible in the bright-field microscope. It thus renders the absolute dependence on staining agents after various fixing materials have been used no longer necessary, and serves as a check to the appearances sometimes given by these agents.

Dark-field microscopy has two requirements that must be met for its successful use as was pointed out by the early investigators with it: (1) a very brilliant light is needed. Full sunlight was recommended and remains the most satisfactory light, although the newly devised electric lights like the small arc lamp and the low-voltage head-light lamps serve very well.

(2) The other difficulty that must be overcome is the large aperture of high-power objectives, especially those of the immersion type. This is because the dark-field condensers can not be constructed with high enough aperture to give a dark-field with these high-power objectives, and they are a necessity with the most exacting work.

Two courses were open with the high powers: (*a*) To so construct them that the aperture was low enough to give dark-field effects with the dark-field condensers practicable to construct, and (*b*) To introduce into the high apertured objectives a diaphragm that should cut down the aperture.

The second course was adopted, and reducing diaphragms of all kinds with apertures varying from 0.40 to 0.90 N. A. have been met with; and in a few cases those as low as 0.20 N. A. were found. Not only was there great variation in the aperture of the reducing diaphragms for the oil-immersion objectives, but in many cases they were so constructed that they were liable to get out of place, get out of the optic axis, and prove generally unsatisfactory. Unfortunately also some of the workers in the pathological field were trying to use oil-immersion objectives for dark-field work with no diaphragm at all, and of course could get no dark-field effects.

After a full examination of the different dark-field condensers made in our own country and abroad, it seemed to me that the best all around aperture for the objective to use with them would be about 0.80 N. A. Such an aperture will give a good dark field with all the standard dark-field condensers, and this aperture is great enough to give good resolution on the one hand and the needed brilliancy on the other.

I appealed to the American manufacturers of microscopic objectives to design and

manufacture oil-immersion objectives of this aperture (0.80 N. A.). With such an objective the worker either in biology or in medicine can get good results even without a very profound knowledge of the optical principles involved. He can also go forward with his work with full confidence that the objective being used will give good results, and every worker knows the importance of confidence in his apparatus for successful accomplishment. Finally, during the past summer and autumn the Bausch and Lomb Optical Company of Rochester, N. Y., undertook the manufacture of the desired medium-apertured oil-immersion objectives. The outcome is all that could be asked; and they have been subjected to the most rigid tests in actual practise in the fields in which dark-field work is applied. These objectives are now available, and the writer feels confident that every one using them will feel grateful for the freedom from worry that was always involved in modifying a high-apertured objective for the dark field.

It is only fair to add that no matter how enthusiastic one may be over the possibilities of dark-field microscopy, much more skill is necessary in it than for the ordinary bright-field microscopy. I think that all who have used the dark-field microscope successfully will agree that the ideal plan for an individual or for a laboratory is to have a microscope devoted to this work alone. If then a proper electric light is available, one can proceed to make examination of specimens with the dark-field microscope with the same certainty and rapidity with which examinations are made with the bright field.

It may be stated in passing with reference to these new objectives, that they have certain advantages for ordinary bright-field work. As ordinarily employed the oil-immersion objectives of high aperture (1.40 to 1.20 N. A.), are used in bright-field work without oil-immersion contact between the under surface of the slide and the top of the bright-field condenser. As light of an aperture greater than 1.00 N. A. can not emerge from the condenser into air, it follows that not nearly all of the available aperture is employed. It was believed therefore that these medium-apertured objectives would serve to give practically as good images for histological, embryological and pathological specimens as the high-apertured objectives as ordinarily used. Actual tests proved the correctness of this supposition. Of course when the resolution of fine details is involved the higher aperture is of great importance, but in order to be fully utilized the microscopic slide must be in immersion contact with the top of the condenser.

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THE INTERNATIONAL GEOLOGICAL CONGRESS COMMITTEE

AT the twelfth session of the International Geological Congress, the president was instructed to nominate a committee to consider the question of a permanent constitution and to submit a proposal thereon to the next session of the Congress. The following committee was appointed: R. W. Brock, President; J. S. Anderson, C. Barrois, A. Karpinsky, A. Renier, Geo. Otis Smith, G. Steinmann and E. Teitze.

The committee met in the rooms of the Geological Society of London on July 20, 1921. There were present: R. W. Brock, President; A. Renier, Geo. Otis Smith and F. D. Adams (ex-officio member).

At a preliminary conference called to obtain for the guidance of the committee the opinion and advice of a wider and more representative body, the following resolution had been passed:

That this meeting is of opinion that the question of the establishment of an International Geological Union should be considered at the next International Geological Congress, and that it is undesirable that any steps should be taken until the question has been so considered at a full and representative gathering of geologists.

A concise proposal with regard to a constitution to submit for the consideration of the next International Geological Congress was drawn up, the main points of which are as follows:

The purpose of the International Geological Congress, it was stated, is to advance scientific investigations relating to the earth from the point of view

of pure geology as well as of its application to the arts and industries.

The sessions of the Congress are called every three or four years, to continue for about one week. At each session, invitations will be received and the meeting place of the next session determined by the Congress. Excursions constitute an important adjunct to the sessions and every possible facility is given to the members to study the geologic structure of the country where they are assembled, and of its mineral resources, at a minimum expense and under the direction of the most competent guides, with guide books specially prepared which serve the double purpose of guiding the excursionists and of presenting a general review of the geology of the country in which the Congress meets.

Standing committees are organized for the purpose of handling questions of general or international interest demanding international collaboration, and the

Congress may award prizes founded for meritorious work within the domain of geologic research.

The organization should be simple and include:

A Committee of Organization, appointed by the host nation, will arrange for that session, its programs and excursions, and its publications.

Officers.—At the first general meeting of the session, the Committee of Organization shall submit nominations for President and Secretary of that session, and the Council shall submit nominations for Vice-President, for elections by duly accredited members.

Council.—The Congress is administered during its sessions by a Council made up of

1. Members of the Committee of Organization for that session.
2. Presidents of Geological Societies.
3. Directors of national and other large geological surveys.
4. Officers elected by the members of the session.

The Council will prepare the order of the day for the meetings.

Standing Committees.—These Committees may be appointed by each Congress to report at the next session, and will be responsible to the Committee of Organization for that next session for the preparation and submission of their reports.

Membership.—Invitations to each session of the Congress are issued by the committees representing the host nation, to recognized geological organizations, universities, and to national governments. Membership in the Congress is generally restricted to geologists of national standing.

Tenure of Office.—The Committee of Organization and officers shall hold office until the close of that session, or until the next committee of organization is formed, to which the documents and files of the Congress shall be transferred. Subcommittees of the local committee shall continue to function until the publications of the session are issued or other business concluded.

The President of the Congress shall, however, preside at the opening meeting of the next session of the Congress, resigning the chair when his successor is elected.

SCIENTIFIC EVENTS

MOLDING SAND RESEARCH

Hundreds of thousands of tons of molding and core sands are used annually in the iron, steel and non-ferrous foundries of America. A little of it is re-used; much more might be. Sands are not always correctly selected for specific purposes. Mixing and other treatment can secure improvement. In what ways can foundry practise as to sands be bettered? What economies can be realized, not only in reduced expenditure for sand, but also in less number of lost castings and higher quality of accepted product?

Last spring, the American Foundrymen's Association decided that thorough study of this subject would be profitable and asked the cooperation of the American Institute of Mining and Metallurgical Engineers. The Institute referred this request to the Division of Engineering of the National Research Council, of which it is a member. Through joint action with the division a valuable digest of the literature has been made by Professor Robert E. Kennedy, of the University of Illinois, and a large committee of foundrymen, engineers and scientific men has been selected, under the general direction of President W. R. Bean, of the Foundrymen's Association and the chairman of the division.

This committee on molding sand research has just been organized with the following officers and executive committee:

Chairman: R. A. Bull, consulting engineer, Sewickley, Pa.

Secretary: Robert E. Kennedy, assistant secretary of the American Foundrymen's Association, Urbana, Illinois.

W. R. Bean, president of the American Foundrymen's Association, Naugatuck, Conn.

Henry B. Hanley, metallurgist and chemist, New London, Conn.

Jesse L. Jones, metallurgist of the Westinghouse Electric and Manufacturing Co., E. Pittsburgh, Pa.

Professor Henry Ries, Department of Geology, Cornell University, Ithaca, New York.

Dr. Bradley Stoughton, consulting engineer, New York City.

Dr. George K. Burgess, chief of the Division of Metallurgy, Bureau of Standards, Washington, D. C.

The committee has thirty-five members, representing the many interests in the use of molding sand.

At a meeting of the executive committee on November 26, in the office of Division of Engineering, Engineering Societies Building, New York City, three subcommittees were appointed to deal (1) with the formulation of standard tests for determining the working properties of molding sand, (2) reclamation of molding sands and greater use of old sands and (3) methods of manufacturing synthetic sands. A meeting of the main committee in the Engineering Societies Building, New York, was planned for December 9, to lay out a comprehensive program of research which will include the assigning of the various problems to appropriate laboratories and industrial plants. Some field work will be necessary in connection with these investigations.

The cooperation of men having like interests in Canada and England is assured and invitations have been extended to France and Belgium.

ALFRED D. FLINN
CHAIRMAN OF THE DIVISION OF ENGINEERING,
NATIONAL RESEARCH COUNCIL

THE BAYARD DOMINICK MARQUESAN EXPEDITION

THE Bayard Dominick Marquesan Expedition for anthropological research has recently returned after fifteen months in Eastern Central Polynesia. The members of the expedition were Dr. E. S. Handy, ethnologist, and Mrs. Handy; and Mr. Ralph Linton, archeologist, members of the staff of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History, of Honolulu, T. H. Nine months were devoted to intensive work in the Marquesan Islands. In addition a considerable amount of ethnological and archeological data were obtained in Tahiti.

The ethnological work of the expedition in the Marquesas was approached with the point of view of reconstructing as near an approach as it is now possible to make to a complete and accurate picture of ancient Marquesan culture. In spite of the fact that the population has been reduced to a very low figure as a result of a hundred years of European contact, and that the ancient culture has been subject to the disintegrating influences of missionary teaching and commercial exploitation for eighty years, the results of this survey are reported to be most satisfactory and illuminating with regard to the relationship of the Marquesan culture to the cultures of other Polynesian and extra-Polynesian peoples.

The archeological survey was accomplished with similar success. Its results will be most illuminating to the body of serious students whose attention is turned on the ethnographic problems of the Pacific.

For the physical survey, which rounded out the anthropological investigations as they had originally been planned, a series of two hundred measurements of full-blooded and mixed Marquesans was obtained, accompanied by observations, hair samples and photographs of every individual. Mr. Louis R. Sullivan, of the American Museum of Natural History, is in charge of the compilation and publication of these anthropometric and somatological data. An early presentation of the results of these researches is planned by the Bishop Museum.

It is felt that at last the inhabitants of the Marquesas and their culture have been, so to speak, charted on the scientific map of the world. The work of this expedition represents the first attempt on the part of the scientific

world to make a thorough and organized anthropological study of this interesting and little-known group.

H. E. G.

LECTURES BY PROFESSOR LORENTZ AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

The following is the provisional outline of the extended course of lectures on "Light and matter" to be delivered by Professor H. A. Lorentz, of Haarlem, Holland, during the winter quarter at the California Institute of Technology at Pasadena:

Older theories of light. Maxwell's theory. Maxwell's equations.
Propagation of light in ponderable bodies.
Huygen's principle.
Interference phenomena. Professor Michelson's methods.
Propagation in a dispersive medium.
Group velocity.
Which is the velocity that is determined by the measurements?
Considerations on (special) relativity.
Fresnel's coefficient.
Momentum, energy and mass.
General considerations on the constitution of electrons, atoms and molecules.
Models of the atom. Thomson, Rutherford, Bohr.
Theory of quanta.
Parson's electron. Lewis's and Langmuir's atom.
Bohr's theory.
Principles of correspondence.
Atoms in stationary states not radiating.
Emission of light. Long trains of waves. Interference with high differences of phase. Structure of spectral lines. Broadening by Doppler effect and other causes.
Scattering of light by molecules.
Dispersion of light.
Anomalous dispersion. Application to solar atmosphere.
Gravitation. Propagation and emission of light in a gravitational field.
Constitution of solid bodies. Atoms held together by electric forces?
Heat motion in crystals.
Magnetism. Theories of diamagnetism and paramagnetism.
Einstein-effect.
Magnetization by rotation.
Quantum theory of the Zeeman effect.
Inverse Zeeman-effect. Older theory. Phenomena observed in the direction inclined to the lines of force. Application to the sun's magnetic field.

In addition to the Lorentz lectures, which will be delivered four times a week from January 4 to March 10, Professor Paul Epstein will give a course on "The origin and significance of the quantum theory."

The California Institute of Technology extends a cordial invitation to investigators in physics, and to teachers in universities, colleges and high schools who are able to do so to attend without charge the Lorentz and Epstein lectures, which will be delivered from 4 to 6 P.M. in the main lecture room of the Norman Bridge Laboratory of Physics.

It is probable that before his return to Holland in April Professor Lorentz will spend a week at the University of Chicago and also at several other universities of the West and Middle West.

THE SECRETARYSHIP OF SIGMA XI

Professor Henry B. Ward, of the University of Illinois, who has been secretary of Sigma Xi since 1904 and has been in large measure responsible for the national development of the Society, writes in the *Sigma Xi Quarterly*:

Two years ago when the quarter-century of service terminated, I made an especially urgent appeal that the work be passed to someone else. Just at that time, however, the society was emerging from the chaotic condition in which all organizations found themselves after the war, and a new project had just been started which bade fair to arouse interest and develop stronger support than any new plan which the society had developed since the earliest years of its history. It was clear to the president and to the members of the fellowship committee, who were intensely interested in this new movement, that a new man could not possibly take up the work of the secretary's office without embarrassing very seriously, and delaying or perhaps fatally injuring the campaign for the establishment of Sigma Xi fellowships. Accordingly, I reluctantly consented to carry the work for one more term, with the positive understanding that my resignation, to take effect in December, 1921, would be final. Under these circumstances, I may be par-

doned for using so prominent a place in the *Quarterly* to give general notice of this fact. It would seem to me unfortunate that the society should come to the election of officers at the Toronto convention without being precisely informed on the matter and having considered carefully candidates for the place. I should not wish in any way to be charged with undue consideration for the work of the office, but I am sure that I should be false to my obligations to the society at large if I did not indicate the proposed change in adequate time for that part of the membership which is interested in the society to give proper thought to the election of my successor. I am sure that the society can secure a better man for the place, but all of us know that chance nominations on the floor of a convention frequently result in the choice of an individual who for various reasons is unable to assume the responsibilities of the position, even though he may be adequately endowed to discharge its duties with credit to himself and entire satisfaction to the organization.

SCIENTIFIC NOTES AND NEWS

The Royal Society has made the following awards: Royal medals to Sir Frank Dyson, astronomer royal, for his researches on the distribution of the stars, and to Dr. F. F. Blackman, for his researches on the gaseous exchange in plants; the Copley medal to Sir Joseph Larmor, for his researches in mathematical physics; the Davy medal to Professor Philippe A. Guye, for his researches in physical chemistry; and the Hughes medal to Professor Niels Bohr, for his researches in theoretical physics.

According to press reports, the Nobel prize for chemistry for 1920 has been awarded to Professor Walter Nernst, of Berlin. The prizes for chemistry and physics for 1921 have been reserved for next year. It is said that the prize in medicine will not be awarded this year, and that the candidates that have been considered most eligible are the English physiologist, Sherrington, the Netherlands professor, Magnus, and the two brain specialists, Henschen of Sweden and Vogt of Germany.

The Jenner Memorial Medal of the Royal Society of Medicine has been awarded to Sir Shirley Forster Murphy in recognition of distinguished work in epidemiologic research.

B. B. Gottsberger has been elected secretary of the Mining and Metallurgical Society of America.

Lathrop E. Roberts, of Northampton, Mass., has been appointed to the staff of the Bureau of Mines at Berkeley, California, to take charge of work in physical chemistry.

Dr. E. D. Ball has been appointed by Secretary Wallace as the representative of the Department of Agriculture on the research information service of the National Research Council to take the place of Dr. Carl L. Alsberg. The secretary has also named Dr. Frederick B. Power, for many years director of the Wellcome Research Laboratory of London and now in charge of the phytochemical laboratory of the bureau of chemistry, as a representative of the bureau in the division of federal relations in the place of Dr. Alsberg.

Professor Warren D. Smith is remaining in the Philippine Islands another year as chief of the Division of Mines, Bureau of Science, his leave of absence from the University of Oregon having been extended.

Walter F. Cameron, formerly deputy chief government geologist, Geological Survey of Queensland, and chairman of the committee on development of oil and gas at Roma, has been appointed mining geologist to the Federated Malay States Government and has commenced his new duties at Ipoh, Kinta District, Perak.

Dr. Clemens Pirquet, professor of pediatrics in the University of Vienna, will deliver the third Harvey Society Lecture at the New York Academy of Medicine, on December 17. His subject will be "Nutrition treatment of tuberculosis in childhood."

Dr. H. H. Love, of Cornell University, has returned to Ithaca, having spent a week each at the Kansas Agricultural College and the Iowa Agricultural College, where a series of lectures were given on the probable error and its relation to experimental results.

The regular lecture at the Johns Hopkins University School of Hygiene and Public Health was given on November 28 by Dr. S. Josephine Baker, director of the Bureau of Child Hygiene, Department of Health, New York, who spoke on "The place of child hygiene in a public health program."

Professor J. H. Mathews, director of the course in chemistry at the University of Wisconsin, lectured before the department of chemistry at Oberlin College, on November 30, on the subjects: "A general survey of photochemistry" and "Color photography." The following evening he spoke before the Cleveland Section of the American Chemical Society on the subject: "Photochemistry and some of its research problems."

The ninety-sixth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Professor J. A. Fleming, F.R.S., on "Electric waves and wireless telephony."

John D. Rockefeller has provided funds for the purchase of the birthplace of Pasteur at Dôle in the Jura. It will be transformed into a museum in which will probably be housed an extensive medical and surgical library, with the authentic documents of Pasteur.

The memorial tablet to the late Lord Rayleigh was unveiled in the north transept of Westminster Abbey on November 30. It is placed between the memorials to Sir Humphry Davy and Dr. Thomas Young.

Dr. Sheridan Delépine, professor of public health and bacteriology and director of the public health laboratory, University of Manchester, died on November 13 at the age of sixty-six years.

Word has been received from Russia of the death on January 2, 1921, at the age of eighty-one years, of Dimitri Konstantinovitch Tschernoff, eminent for his work on the metallography of iron.

The annual meeting of the Society of Economic Geologists will be held in conjunction with the annual meeting of the Geological Society of America at Amherst College from December 28 to 30.

Formal organization of the American Association of Textile Chemists and Colorists was completed at a meeting held in the Engineers' Club at Boston on November 3. Professor Louis A. Olney, of the Lowell Textile School, was elected president.

The Institution of Rubber Industry held its first meeting in the lecture hall of the Royal Society of Arts on October 19, when Mr. J. H. C. Brooking delivered a presidential address.

An International Congress of Maternal and Child Welfare will be held in Paris, July 6 to 8, 1922.

At a meeting of the British Optical Society held on October 13, the resolution passed early in 1915 suspending certain members, subjects of countries then at war with Great Britain, was revoked.

Steps have been taken to organize the engineers of the British Empire on the lines pursued by the Federated American Engineering Societies.

Beginning with the January issue, the *Journal of Orthopedic Surgery*, the official organ of the American Orthopedic Association and of the British Orthopedic Association, has announced that the publication will change from a monthly to a quarterly publication.

Astronomical journals report that early in 1920 following a call sent out by leading German men of science, an Einstein fund was raised. The purpose of the fund is to test the relativity theory experimentally and to make possible the development in Germany of its astrophysical consequences. Sufficient funds were obtained, thanks to the Ministry and Germany Industry, to undertake the construction of a tower-telescope and a physical laboratory.

Professor William Herbert Hobbs, now making a geological reconnaissance in charge of the Osborn Expedition from the University

of Michigan, has reached Manila after six weeks spent in examining the Bonin, Marianne and Caroline Islands in the western Pacific Ocean. Until he reached Yap on September 11, he was traveling as the guest of the Japanese Navy Department. At Yap the U. S. gunboat *Bittern* was placed at his disposal and the Pelews and scattered islands to the southwest were visited. He sailed on the *Bittern* on October 3 for a 4000-mile cruise along the great Sumatra mountain arc and through the Nicobar and Andaman islands to Rangoon, Burmah. He will then proceed to Europe to lecture at the Univesities of Delft and Utrecht, during the spring semester.

UNIVERSITY AND EDUCATIONAL NEWS

The *Journal* of the American Medical Association states that the University of Colorado is waging an active campaign to raise the remaining $200,000 necessary to insure the erection of the new medical school and state hospital. Toward the $1,500,000 which the project will cost, the General Education Board has pledged $700,000 and the state has appropriated $600,000, both sums contingent upon the raising of the $200,000 balance by the university. An effort will be made to obtain one dollar from each of 200,000 citizens of Colorado.

Dr. Elihu Thomson, chief consulting engineer of the General Electric Company, has again been appointed acting president of the Massachusetts Institute of Technology, a post which he filled after the death of Dr. Richard C. Maclaurin in January, 1920, and will continue until a successor to President Nichols is named. The educational affairs of the institute will continue to be directed by a faculty administrative committee consisting of Professor Henry P. Talbot, head of the department of chemistry and acting dean; Professor Edward F. Miller, head of the department of mechanical engineering and chairman of the faculty, and Professor Edwin B. Wilson, head of the department of physics.

Eliot Blackwelder, A.B., Ph.D. (Chicago), will become professor of geology at Stanford University next year, succeeding Dr. Bailey Willis, who will retire in accordance with the provision by which professors of Stanford become emeritus at the age of sixty-five. Professor Blackwelder is now lecturing at Harvard, filling the place of Professor Daly, who is absent on leave in South Africa.

E. H. Wells, who has conducted special geological investigations for the Chino Copper Company, has been elected president of the New Mexico State School of Mines at Socorro.

Dr. E. Eugene Barker, formerly assistant professor of plant breeding in Cornell University and more recently of the Insular Government Service, Las Piedras, Porto Rico, has become associate professor of botany, with particular reference to genetics, in the University of Georgia.

C. W. Watson, a graduate of the Yale Forest School in 1920, has been called to the School of Forestry, University of Idaho, as instructor in forestry. Mr. Watson spent the past year in study abroad under a traveling fellowship in forestry granted by the American-Scandinavian Foundation.

Mr. Stanley Wyatt, investigator to the Industrial Fatigue Research Board in England, has been appointed lecturer in psychology at the University of Manchester.

Col. Sir Gerald Lenox-Conyngham, F.R.S., has been appointed fellow and prelector in geodesy at Trinity College, Cambridge.

DISCUSSION AND CORRESPONDENCE

AN ENGLISH TRANSLATION OF HELMHOLTZ'S "OPTIK"

To the Editor of Science: Many readers of Science will be glad to know that the council of the Optical Society has appointed a committee to make arrangements for bringing out an English translation of Helmholtz's great work on physiological optics.

The first edition of the "Handbuch der physiologischen Optik" was published in 1866, more than half a century ago; and the fact that this epoch-making work, which remains to-day the most original treatise on physiolog-

ical optics, has never been translated into English, is a reproach to both Great Britain and America. To make its valuable contents accessible to those who do not find it easy or convenient to read a foreign language will be conferring a boon on many scientific investigators in the vast and expanding territory which this book was originally intended to cover.

Incidentally, the proposed English edition will be a memorial of the hundredth anniversary of the birth of Hermann von Helmholtz, whose influence on modern scientific thought in nearly every direction has perhaps been as widespread and permanent as that of any of his great contemporaries in the nineteenth century.

It is estimated that the cost of translating, editing, and publishing this memorial volume (or volumes) will be $5,000 or more. It is particularly desired that every individual who is interested in the success of this project and in the advancement of the science of light and vision in this country will have an opportunity of contributing towards it.

Contributions, no matter how small, may be sent to Adolph Lomb, Esq., treasurer of the Optical Society of America, care of Bausch & Lomb Optical Company, Rochester, New York. Make cheques payable to "Adolph Lomb, Treasurer."

Any one subscribing as much as $15 will receive a copy of the complete work when it is issued.

James P. C. Southall,
President, Optical Society of America

Department of Physics,
Columbia University,
November 28, 1921

THE AMERICAN SOCIETY OF NATURALISTS

The thirty-ninth meeting of the American Society of Naturalists, as has been noted in Science, is to be held in Toronto on December 29 and 30, with two symposiums of unusual interest—one on genetics and variation, by the zoologists, the other on orthogenesis, in which Henderson, Osborn, Bateson and others will take part.

It is interesting to recall that for the first three years the society was under a paleontologist, Alfred Hyatt; for the two succeeding years under a zoologist, Grove K. Gilbert; then for two years under a comparative anatomist, Harrison Allen. Then in turn the society was presided over by the botanist Goodale, the physiologist Martin, the geologist Rice, the paleontologist Osborn, and a succession of paleontologists and zoologists until 1902, when the psychologist Cattell presided, since which time it has been chiefly under the guidance of zoologists.

The keynote to the success of the Society of Naturalists was the discovery that a more representative body of scientific men can be assembled at a winter meeting than at a summer session. This society has proved to be the mother of societies, because from its broad original organization have gone forth the six national American societies of Geology, Anatomy, Physiology, Botany, Zoology, and Paleontology, all holding winter meetings in various parts of the United States, from the eastern seaboard to Chicago. The zoologists alone cling to the mother Society of Naturalists and hold their meetings in the same time and place.

Of the founders of the Naturalists in the year 1883 there now survive the following: Libbey, Osborn, Scott, Rice and Clarke, the latter, Professor Samuel F. Clarke of Williamstown, being one of the first to answer the call.

Henry Fairfield Osborn

THE PROGRAM OF THE SECTION OF BOTANY FOR THE TORONTO MEETING

Arrangements have been completed to hold the Section G program on Wednesday afternoon, December 28. Since this program will be of interest to others than the members of this Section the speakers are given below.

Address of the Retiring Vice-President, Dr. Rodney H. True, "The physiological significance of calcium for higher green plants."

Symposium on "The Species Concept"

From the viewpoint of the systematist: Dr. Charles F. Millspaugh.

From the viewpoint of a geneticist: Dr. George H. Shull.

From the viewpoint of a morphologist: Dr. R. A. Harper.
From the viewpoint of a bacteriologist and physiologist: Dr. Guilford B. Reed.
From the viewpoint of a pathologist: Dr. E. C. Stakman.

The address of the retiring vice-president will be thirty minutes in length, and each speaker in the symposium has agreed to limit his paper to fifteen minutes. This should allow considerable time for discussion.

Robert B. Wylie,
Secretary

THE TWENTIETH INTERNATIONAL CONGRESS OF AMERICANISTS

The Twentieth International Congress of Americanists, which was to be held in Rio de Janeiro in 1921 but had to be postponed, will be held definitely from August 20 to 30, 1922, in connection with the celebration by Brazil of its first century of independence.

The organizing committee of the congress announces a rich and attractive program, and in view of the importance of Brazil to American Anthropology it is hoped that a special effort will be made by Americanists in this country to attend the congress, or at least to become members. Application for membership, with the dues of $5, may be sent directly to the Secretary of the coming Congress, Sr. Domingos Sergio de Carvalho, Praça 15 de Novembro N. 101, Rio de Janeiro, Brazil; or to the writer.

Aleš Hrdlička
Sec. Gen. XIXth I. C. A.
U. S. National Museum,
December 3, 1921

FOSSIL MAN FROM RHODESIA

The British press has just announced the discovery of a fossil human skull from northern Rhodesia that may prove to be epoch-making. It was found in the "Bone Cave" at Broken Hill mine, and bids fair to be of the first importance in its bearing on the physical characters of fossil man. The cranium is practically complete and in a perfect state of preservation; the lower jaw was not recovered. Judging from the newspaper half-tones, the cranium is of a more lowly type than any Neandertal cranium yet discovered; it remains to be seen after a full report has been published whether we may not have here a new species of *Homo* about midway between *Pithecanthropus erectus* and the *Homo neandertalensis.*

The face is intact; the prognathism of the upper jaw is extremely accentuated, this being possible partly because of the unusual maxillary height between the anterior nasal spine and the alveolar margin. The nasal bridge is fairly prominent, a character which has recently come to be recognized as belonging to the Neandertal race.

The brow ridges are more pronounced than in any other known fossil human skull. The cranial height and breadth are correspondingly small, pointing to a comparatively low cranial capacity.

This precious relic is at the British Museum, South Kensington. It will be examined by Dr. A. Smith Woodward and Professors Arthur Keith and Elliott Smith, to whom science is so much indebted for their reports on the Piltdown remains; the result of their study of the cranium from the cave at Broken Hill mine will be awaited with intense interest. If the efforts to find the lower jaw should be rewarded, they may result in throwing new light on the Piltdown paradox.

George Grant MacCurdy
Director, American School in France for Prehistoric Studies

SCIENTIFIC BOOKS

Physiology and Biochemistry in Modern Medicine. By J. J. R. Macleod. 3d edition. St. Louis, C. V. Mosby Co., 1920. Price $10.

The third edition of this interesting textbook has been largely revised and partly rewritten. The changes are uniformly improvements, and the whole book is well written and filled with important methods and facts which are interestingly discussed. Dr. Macleod describes the advances in the

medical sciences, particularly in their bearing upon clinical medicine and human physiology. This point of view is most important and far too often neglected in our American schools of medicine, where the medical sciences and clinics are so thoroughly dissociated. The book should continue to be of general interest to the medical profession as it is of nearly equal value to medical students and to our practising physicians.

It is somewhat unfortunate that the publishing has been made so elaborate. If there were fewer colored illustrations and fewer plates the price of the book could probably have been markedly reduced without a corresponding reduction of its instructive value.

J. C. Aub

Harvard Medical School

Triassic Fishes from Spitzbergen. By Erik A:son Stensiö. Upsala, 1921.

This is one of the most important paleontological memoirs which has appeared in recent years. It represents an attempt to distinguish fossil fishes as organisms, rather than as horizon markers. The geological aspects of the question are, however, thoroughly discussed.

Stensiö is a student of Professor C. Wiman of Upsala, whose contributions during the last few years have interested paleontologists in the fauna of ancient Spitzbergen. Wiman has sent or led expeditions into Spitzbergen since 1908, and on the basis of the material thus assembled the present writer Stensiö has based his account.

The quarto, representing Part I. of Stensiö's studies, consists of 307 pages of printed matter, 35 plates and 90 figures in the text. The presswork coming from Vienna is excellent. The plates represent photographic reproductions of the fossils, with Stensiö's interpretations of the anatomy lettered in white ink in the photographs. The results are especially pleasing and easy of reference.

Elasmobranchs, dipnoans, crossopterygians and three families of Actinopterygii constitute the fauna and Stensiö has described and interpreted his findings in a very excellent manner. Especially interesting are his accounts of the sensory canals of the head; the relationship of the crossopterygians and the tetrapods and the correlations of the primordial ossifications of the head of these primitive forms. It is a grateful relief to find taxonomy in the background. Nomenclature often absorbs more space than is needful.

Roy L. Moodie

University of Illinois,
Department of Anatomy,
Chicago

SPECIAL ARTICLES

INHIBITORY EFFECT OF DERMAL SECRETION OF THE SEA-URCHIN UPON THE FERTILIZABILITY OF THE EGG

In the early part of September of this year (1921), while working in the Marine Biological Laboratory at Woods Hole, Mass.,[1] I happened to find a striking fact that the eggs of *Arbacia punctulata* obtained through the genital pores, as most commonly practised,[2] did not develop at all, whereas those taken out from inside the shell developed normally. The results of a few but repeated experiments carried out with regard to this peculiar phenomenon may be given summarily as follows:

The eggs which escaped through the genital pores of opened sea-urchins, and were then transferred to clean sea-water in finger bowls, but subjected to no subsequent washing, were seen attracting spermatozoa but no fertilization occurred. These eggs were later washed repeatedly with clean sea-water at various intervals. If simply washed they never developed. But at a fresh insemination these washed eggs began to develop; thus, for example, the eggs washed and inseminated after standing for 50 hours in room temperature were found still capable of developing into normal and healthy

[1] My hearty thanks are due to Professor E. B. Wilson for the privilege of the use of a Columbia University table in the Marine Biological Laboratory, and to Professor F. R. Lillie, director, and other members of the staff of the said laboratory for every facility for my work. Further, to Professor E. G. Conklin, who has kindly criticized and corrected the manuscript, I express my sincere thanks.

[2] See F. R. Lillie, *Biol. Bull.*, XXVIII., 4, 1915, p. 231.

plutei. Of those which had stood for more than 57 hours, however, only a very few reached the four-cell stage, no further development taking place.

The eggs taken out from inside the shell, on the other hand, showed invariably a high fertilizability, even when much of the "perivisceral fluid" ("blood") had been mixed in water and no washing followed. After more than 28 hours' standing in room temperature, and without subsequent washing, they could be fertilized and they developed into plutei, while among those which had stood for more than 47 hours very few could segment and reach the gastrula stage.[3]

The substance, which inhibits the fertilization and which probably can, to some extent, thus prolong the life of the unfertilized egg, has been found to come from the surface of the body of the sea-urchin. This I may call "dermal secretion." If a sea-urchin is opened and inverted over a dry dish for a while some dull yellowish fluid collects in the dish. When the eggs taken out from inside the shell were inseminated *in* this "dermal secretion," no matter whether the latter had been obtained from male or female animals, fertilization was found inhibited in varying degrees according to the concentration of the fluid. The dermal secretion, when present in a 5 per cent. concentration in sea-water, was found sufficient to inhibit all the eggs from fertilization. In 2.5 per cent. solution about 10 per cent. of the eggs fertilized, and in 1 per cent. solution about 50 per cent. of the eggs developed. When present in less than 0.5 per cent. concentration practically every egg could be fertilized.

If, however, the eggs were treated with a strong solution of this substance *after* fertilization no injurious effect was found on the early development as late as the pluteous stage. The activity of the spermatozoa also does not seem to change in this fluid.

The dermal secretion thus obtained from *Arbacia* has some inhibitory action also on the eggs of the sand-dollar, *Echinarachnius parma,* though in a lower degree. In a 15 per cent. solution of this fluid in sea-water none of the sand-dollar eggs were found fertilized, in a 10 per cent. solution about 1 per cent. of the eggs developed, and in a 5 per cent. solution about 20 per cent. of the eggs developed.

Through the kindness of Dr. H. C. van der Heyde the substance in question was shown to contain uric acid. From lack of sufficient time I was unable to see if uric acid alone dissolved in sea-water would exhibit the same action upon the egg as the dermal secretion does.

The same substance could also be obtained in some other ways: for example, by placing an *intact* sea-urchin on a dish for a while, no matter which side down, after being washed with fresh water, or by irritating the animal with the sharp point of a glass needle instead of treating with fresh water. On the other hand, sea-water in which some scraped pieces of skin, tube-feet, spines, etc., had been soaked for some time showed very little inhibitory effect upon the fertilizability of the egg.

According to Lillie[4] the perivisceral fluid of *Arbacia inhibits* the fertilizability of the egg, whereas the dermal secretion *protects* the egg from the inhibitory action of the former. I have found that the perivisceral fluid had very weak inhibitory action upon the fertilizability of the egg; thus in a 50 per cent. solution of the same in sea-water about 5 per cent. of the eggs fertilized, and even in a 75 per cent. solution about 1 per cent. of the eggs could be fertilized. Although it may seem quite contrary to Lillie's conclusions, my results rather confirm his view that the inhibitory action of the perivisceral fluid increases during the period when sexual elements are ripe. Lillie's experiments were mostly made in July, when the gonads of *Arbacia* are quite active, while the breeding season comes nearly to an end early in September, when my material was obtained.

It is well known that among Echinoderms, especially Holothurians, there are several species in which the eggs are fertilized and develop inside the mother's body-cavity. In such cases it seems highly improbable that a

[3] As to the longevity of the unfertilized egg of *Arbacia* see A. J. Goldfarb, *Biol. Bull.*, XXXIV., 6, 1918, pp. 393–5; and E. N. Harvey, *Biol. Bull.*, XXVII., 5, 1914, p. 238.

[4] *Jour. Exper. Zool.*, XVI., 4, 1914, pp. 570–7.

strong inhibitory action of the perivisceral fluid upon fertilization should occur at the breeding season. As to the action of the dermal secretion there seems to be hardly any biological significance, since under natural conditions neither egg nor sperm encounters such a high concentration of the secretion as suffices to inhibit fertilization.

Having been engaged in other work, I could not carry out this series of experiments more fully and accurately. But, as I shall not have further opportunity of dealing with this Atlantic species, I have here ventured to communicate this incomplete note, simply with the hope that it may lead to further research on the seasonal changes in the effects of the "dermal secretion" and the "perivisceral fluid" of the sea-urchin upon the fertilizability of the egg.

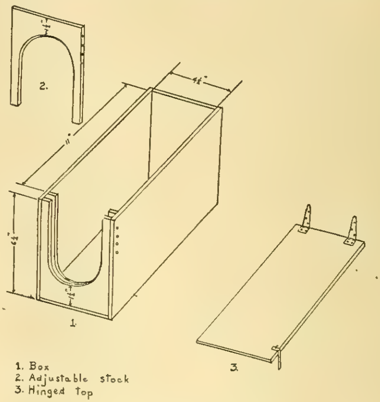
Hiroshi Ohshima
Princeton University

SIMPLE METHOD OF BLEEDING RABBITS

The simplest method of obtaining rabbit's blood, when more than a few drops are necessary, is that of bleeding from the median artery of the ear. This vessel stands out prominently and is easy of entrance, if the animal is full grown. As much blood can be taken by this method as directly from the heart, and either a syringe may be used, or a cannula only, with a tube to receive the fluid.

The chief advantage of bleeding from this vessel is that small quantities of blood (3 c.c. to 5 c.c.) may be obtained at frequent intervals (daily, if necessary), each point of entry being successively nearer the base of the ear. Ten or more cubic centimeters may be obtained just as easily.

It is occasionally found that even when the needle seems to be safely within the artery, a good flow does not follow. This is sometimes caused by a plug of skin blocking the passage of the blood, but more often it will be found that there are two smaller arteries in place of the single larger one, with a consequently smaller flow in each. Animals which have the single vessel should for this reason be selected. In general, the larger the vessel, the greater is the ease of obtaining blood. A sharp needle is essential, because, due to the thickness and toughness of the arterial walls, a somewhat dull point will almost invariably pass around the vessel rather than into it. A small needle is best because of the smaller puncture it makes, and the consequently greater ease of stopping the blood after withdrawal. A 21- to 23-gauge needle has been found by the writer to be most satisfactory.



Cage for Bleeding Rabbits

Little trouble is experienced in stopping the flow upon withdrawal of the cannula, usually no more than following withdrawal from a vein. Potassium alum will very quickly stop the bleeding where it will not do so naturally.

The marginal ear vein may also be used in the same way, though it is difficult to obtain more than a cubic centimeter or two therefrom on account of the lower pressure and decreased flow in the veins. The needle must, of course, in all cases be inserted opposite to the direction of the blood flow.

White rabbits, or rabbits with white ears, are much the most suitable sort for this work for obvious reasons. Injections into and bleedings from ear vessels are greatly facilitated by placing an electric light below the ear in such a position as to make the ear translucent. If alcohol is applied on a bit of ab-

sorbent cotton, the double purpose is served of stimulation of the vessels, causing them to dilate, and of plastering down the hair upon the skin, making the veins and arteries more visible. When the needle is withdrawn the alcohol must be well wiped off before the wound will close. Sometimes when an attempt to enter the median artery is for any reason unsuccessful, the blood will be seen to leave the vessel entirely and remain so for a considerable time, due to contraction of the arterial wall which was probably pricked by the needle. Vigorous rubbing, however, will bring the normal circulation back.

Shaving or sterilizing the ear is unnecessary when it is not desired to preserve the blood for more than immediate use. Several hundred injections and bleedings during the past year or two have shown no ill effects whatever. Rabbits apparently rival avian forms in their resistance to infection. Numerous subcutaneous and intraperitoneal injections without shaving or sterilizing the body surface have not shown a single infection.

A very useful sort of cage, designed by Mr. George H. Bishop for use in this laboratory, makes it simple for one to perform injections and bleedings alone. A box about eleven inches long, four and a half wide, and six and a half deep (inside measurements), has a stock at the front end, the upper half of which operates in a slot, and which may be fastened so as to allow an opening of any desired size, through which the animal's head and neck protrude. A hinged top prevents kicking up behind. Rabbits take very quietly to this temporary confinement once they are placed inside the box, and are not then able to jump and misdirect the needle so easily as when one is attempting to hold the animal. This cage is here illustrated.

GEORGE F. FORSTER
ZOOLOGICAL LABORATORY,
UNIVERSITY OF WISCONSIN

ADSORPTION BY SOIL COLLOIDS

(PRELIMINARY PAPER)

FOR some time we have been working on the adsorption of soil colloids. We believed that this problem could best be solved by preparing these soil colloids separately in the purest possible condition, and then trying each colloid with the nine following respective salts: potassium nitrate, potassium sulphate, potassium acid phosphate, calcium nitrate, calcium sulphate, calcium acid phosphate, magnesium nitrate, magnesium sulphate, magnesium acid phosphate.

The individual salts have been tried on silica, aluminium, and iron gels, and the humus is now in the process of preparation. We have worked on the adsorption of each ion separately. A few results are given to show the trend of the work.

ADSORPTION BY SILICA GEL

Conc.	Mg. of Ca Adsorbed per Gram of Gel	Mg. of PO_4 Adsorbed per Gram of Gel
N/10	—0.013	0.358
N/20	—0.034	0.114
N/40	0.032	0.037
N/400	0.023	0.045

ADSORPTION BY IRON GEL

Conc.	Mg. of Mg. Adsorbed per Gram of Gel	Mg. of SO_4 Adsorbed per Gram of Gel
N	9.7	31.9
N/5	8.0	30.7
N/10	5.7	28.3
N/20	4.3	23.2

ADSORPTION OF ALUMINIUM GEL

Conc.	Mg. of P_2O_5 Adsorbed per Gram of Gel in 1 Week	2 Weeks	4 Weeks	6 Weeks
N/10	261.0	291.5	338.0	385.5
N/20	221.5	256.7	281.0	317.0
N/40	186.3	191.1	197.3	210.5

There was less than the equivalent amount of calcium adsorbed at the various concentrations.

ADSORPTION OF SILICA GEL AT VARIOUS P_H VALUES

P_h Value	Mg. of K Adsorbed per Gram of Gel
3.888	—0.68
6.086	1.74
7.692	6.56
9.501	9.62

We have also varied hydrogen ion concentration and followed the adsorption curves for the respective ions with the idea of show-

ing some relation between the acidity of the soil and adsorption. This work is giving most interesting results.

Many of these results speak for themselves, but a discussion together with a full report of all results is being published elsewhere.

Neil E. Gordon,
R. C. Wiley,
E. B. Starky,
A. L. Flenner,
D. C. Lichtenwalner
University of Maryland

THE AMERICAN CHEMICAL SOCIETY.

(*Continued*)

Luminescence of parabromophenyl magnesium bromide and related compounds: W. V. Evans and R. T. Rufford.

A simplified titrating hydrogen electrode and its use in a plant laboratory: Felix A. Elliott. The hydrogen electrode previously described by the author has been modified for use in titrations. It has been possible to meet the three important conditions of (1) working in a hydrogen atmosphere, (2) efficient and quick mixture of the solution being titrated with the acid, alkali or other solution, and (3) eliminating the contact potential and at the same time maintaining a constant volume of the solution under investigation, without undue complications in the design and without mechanical agitation. The internal resistance of the cell has been kept very low, thus insuring ample sensibility with the more rugged types of measuring instruments. The apparatus is portable. When fitted with platinized platinum electrodes this cell may be used to determine the content of lime and magnesia in limestone, the amount of acid or alkali in various plant liquors, examples being given. With bright platinum electrodes the cell may be used for such titrations as I with sodium thiosulphate, Fe with sodium dichromate and other titrations involving similar reactions with a change in the charge on one of the ionic species in solutions.

High frequency ozone production: F. O. Anderegg. To eliminate the dielectric, which is the greatest weakness with commercial ozonizers, advantage was taken of the fact that it is impossible to maintain a high frequency arc. An aluminium tube 5 x 190 cm. with a concentric wire was used for the discharge. Current was supplied up to half an ampere and 7000 volts at about a million and a half cycles frequency by a small Tesla coil which was designed so as to give the best discharge with the tube used. The highest yields were secured with a rather large wire provided with numerous small points so that the discharge should be made up of many brushes. The ozonized air contained but small amounts of nitrous oxides although on raising the voltage till the discharge was filled with sparks about 0.02 per cent. was obtained. Numerous curves have been worked out showing the relationships between the different variables which are usually similar to those obtained in low frequency ozone production. Maximum concentration was 15 gram per cubic meter. The greatest efficiency obtained was 17 gram per kilowatt hour which in view of the wasteful method of producing the high frequency current is encouraging.

The reaction between tungsten and hydrocarbon vapors: Saul Dushman.

The activity of ions in mixed electrolytes: C. E. Ruby, T. W. Bartram and Y. L. Yeh. The electromotive-force of cells of the type H_2 (1 atm.), HCl (c_{10}) + MCl (c_2), AgCl, Ag were measured, in which MCl was, in the two sets of experiments, KCl and NaCl respectively, and the sum of the weight-normal concentrations ($c_1 \pm c_2$), was held constant in each set of measurements, c_1 being varied ten-thousand-fold. Four sets of measurements were made, employing the values of .2, and 1.0 weight-normal for the sum of c_1 and c_2. The results obtained in these experiments are interpreted in the light of the theory of independent ion-activity.

The atomic structure: Upon the subtlety of directed particle motion hang all the properties of matter: H. K. Kipper. By our theory we postulate that: Light is a wave motion of the particles of the ether. Electricity is a helical or screw motion of the particles of the ether (whether atomic or unorganized). Magnetism is a compensated helical or screw motion of particles. Gravity is a function of rotatory motion. Chemical affinity or valency is based on the forces derived from the specific groups of electrons. Solution affinity is based on the forces derived from all groups—that is, such forces taken as a field. All atomic forces are mechanically or mathematically derivable and interpretable from motions of particles in themselves representing simply energy and matter.

The cryoscopy of boron trifluoride solutions: VI: System with methyl chloride: Albert F. O. Germann and Marion Cleaveland. P. F. G. Boullay

pointed out, early in the nineteenth century, that ethyl chloride prepared by the method of Dumas and Peligot contains ethyl ether as an impurity. In a paper presented at the last meeting of this Society (see SCIENCE, 53, 582 (1921)), we showed that methyl chloride prepared by the above method (that is 'rom salt, sulfuric acid and methyl alcohol) could not readily be separated from methyl ether which it contains as impurity, and that the presence of methyl ether can be detected by addition of boron trifluoride, which forms the molecular compound $(CH_3)_2O.BF_3$, boiling at 126° C., and remaining as a slightly volatile residue after evaporation of the excess of either gaseous constituent. At the present time, methyl chloride prepared by chlorination of natural gas is available and a sample was obtained through Roessler and Hasslacher. This sample appeared to contain methane, which is somewhat soluble in liquid methyl chloride. A large sample was collected and fractionally distilled five times, after which it distilled at a uniform pressure. Tested by addition of boron trifluoride, the product was completely volatile, showing that the sample was free from methyl ether. The freezing point curve obtained shows a sharp eutectic at 30 per cent. of methyl chloride, where the freezing point was about 137 degrees below zero. There is no indication of the formation of a compound between methyl chloride and boron trifluoride.

The application of a differential thermometer in ebullioscopy: ALAN W. C. MENZIES AND SYDNEY L. WRIGHT, JR. The differential thermometer, perhaps 12 cm. long, is extremely simple but of novel type, consisting essentially of a stout glass U-tube containing only water and its vapor, and measures the difference in temperature between the solution and the pure solvent. Both limbs of the thermometer are located in the vapor phase; one of them is laved continually with the solution by means of a Cottrell pump, while the other is laved only by condensed solvent. The apparatus uses neither corks nor stopcocks, is rather insensitive to draughts and to changes in heating, and is unaffected by barometric fluctuation. Results are consistent to one half of one per cent.

The decolorizing action of boneblack: CLAUDE H. HALL, JR. The author has repeated and confirmed the work of Patterson. By extraction of hydrochloric acid washed boneblack with sulfuric acid an extremely active decolorizing agent may be prepared. By precipitating this compound on wood charcoal, or other porous substances, a material identical in chemical action with boneblack is obtained. This is the final link in the chain of evidence proving that the decolorizing action of boneblack is due to certain nitrogeneous compounds, the empirical formula and some of the properties of which are described in the previous reference.

Effect of electrostatic potential on the activity of a catalytic surface: A. S. RICHARDSON.

The selenides of ammonium: C. R. MCCROSKY AND A. J. KING. Pure dry NH_3 and H_2Se were admitted to a special weighing tube, free from oxygen. White crystals form when H_2Se is in excess—analyzing from 76 per cent.[1] to 80 per cent. Se, corresponding closely to NH_4HSe. This salt dissociates without melting at 100° to 120°. When NH_3 is in excess and the temperature of the tube is kept at from 20° to 30°, a liquid forms, practically colorless. (The heat of formation of NH_4HSe is great enough to prevent the formation of the liquid unless the tube is cooled to room temperature.) The analysis of this liquid shows Se 68 per cent. agreeing with the theoretical for $(NH_4)_2Se$. It freezes at approximately 10° and decomposes at 30° to 40° leaving the white crystals of the hydroselenide. Bineau (1838) claims that $(NH_4)_2Se$ is a white solid, also that NH_4HSe is a white solid. Lehner and Smith (1898) prepared a dark-colored crystalline solid from water solution, which corresponded to $(NH_4)_2Se$. Further definite data are lacking in the literature.

The correlation of compound formation and ionization in solutions: JAMES KENDALL AND PAUL M. GROSS. The complete specific conductivity-composition curves for 14 systems of the types: acid-ester, acid-ketone, acid-acid and acid-base have been determined. The conductivities of mixtures of the above types are, in general, considerably in excess of those of the pure components, and increase uniformly with increasing diversity in chemical character of these components. The results obtained have been correlated with those derived from freezing-point measurements upon similar systems, and the validity of the fundamental connection between compound formation and ionization in solutions, postulated in previous articles, has been confirmed.

The prediction of solubility in polar solutions: JAMES KENDALL, ARTHUR W. DAVIDSON AND HOWARD ADLER. The influence of compound formation between solvent and solute on the degree of

[1] Errors in the method, found later, in all probability account for the low values. These errors were overcome in later determinations.

solubility is critically discussed. It is shown that: (*a*) for a *fixed* solute in a series of *different* solvents, increasing solubility and increasing compound formation proceed in parallel; (*b*) for a series of *different* solutes of high melting-point in a *fixed* solvent, solubility and compound formation also proceed in parallel at low temperatures. Salts of a very weak base exhibit increasing hydrate formation and increasing solubility in water as the acid radical X diverges from OH; salts of a very weak acid show the same behavior as R diverges from H. The increase in the solubility of a difficultly soluble salt in water on addition of a second salt containing a common ion, due to complex salt formation, is dependent upon the diversity of the variable radicals. The extension of these rules to non-aqueous solutions and their importance in analytical chemistry are noted.

The complete analysis of an insoluble silicate with a single fusion: F. P. DUNNINGTON. Fuse the powdered silicate with six parts of lithium carbonate in a gold crucible. The melt is dissolved in dilute acid, evaporated, heated and the silica separated as usual. To the solution of chlorides add ammonia, etc. To remove alumina, iron and manganese, precipitate lime as oxalate; magnesia by ammonium phosphate and then, with little calcium chloride and ammonium carbonate remove all excess of phosphoric oxide; evaporate filtrate, volatilize ammonium salts. The residue is digested in a mixture of absolute alcohol and ether, which readily dissolves the lithium chloride; filter off the potassium and sodium chlorides, weigh and separate them.

Alizarine-iron lakes: A. W. BULL AND J. R. ADAMS.

Adsorption of tannin by gelatine: A. W. BULL AND J. R. ADAMS.

The theory of molecular-compound formation: V. R. KOKATNUR AND H. W. STIEGLER. This theory is based on an observation that molecules in molecular compounds invariably contain elements that belong to 5, 6, 7, 8 groups of the periodic system. Assumptions: (1) Molecules combine through unsaturation or through latent valences of elements, especially non-metallic, belonging to aforesaid periodic groups. (2) These elements exhibit their highest capable valence and combine through these by single or double bonds. But all their valences may not be satisfied. (3) Active groups and conditions of molecules may influence this latent valency and give rise to chain-compounds and consequent isomerism.

The diffusion of hydrogen through metals: H. G. DEMING AND B. C. HENDRICKS. Sheet metal of 0.15 mm. thickness was clamped between heavy steel blocks in an electric furnace, the diffusion area being circumscribed on the face of each block by a pair of concentric circular knife-edges. The channel between the knife-edges in the block on the incoming side was connected to a vacuum-pump; on the outgoing side to compressed nitrogen. The diffusion was thus limited to a definite area of metal or perfectly uniform temperature, even though the blocks were never pressed against the metal tight enough to make a gas-tight joint. Aluminum is impervious to hydrogen up to its melting point. Quantitative data have been obtained for copper, iron, and other metals.

The adsorptive property of fullers earth: STUART J. BATES AND ALFRED STAMM.

CHARLES L. PARSONS,
Secretary

AMERICAN MATHEMATICAL SOCIETY

THE two hundred and seventeenth regular meeting of the American Mathematical Society was held at Columbia University, on Saturday, October 29, 1921, extending through the usual morning and afternoon sessions. The attendance included forty members of the society. Thirty new members were elected.

The following papers were read at this meeting:

Total geodesic curvature: J. K. WHITTEMORE.

On the composition of polynomials: J. F. RITT.

Complete determination of polynomials whose inverses can be expressed in terms of radicals: J. F. RITT.

Concerning continuous curves in the plane: R. L. MOORE.

Concerning the relation of a continuous curve to its complement in space of three dimensions: R. L. MOORE.

An algebraic solution of Einstein's cosmological equations: EDWARD KASNER.

On biharmonic functions: T. H. GRONWALL.

General formulation of a combinatory method used by William Emerson and others: L. H. RICE.

A theorem on loci connected with cross-ratios: J. L. WALSH.

A generalization of the notion of covariants: L. B. ROBINSON.

Inductances of grounded circuits: G. A. CAMPBELL.

R. G. D. RICHARDSON,
Secretary

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THE PRESENT STATUS OF THE HISTORY OF SCIENCE IN AMERICAN COLLEGES AND UNIVERSITIES

During the past few years there have been several attempts to establish beyond question the value of a study of the history of science in American colleges. A little has been written in defense of the subject as a proper part of the curriculum, and a few science teachers have spared no effort in the critical study and presentation of the history of the particular phase of science with which they have been most familiar. And yet, the papers that have been written in English dealing at all directly with this history are so few in number that they all may be read in a very few hours. Of histories of science—books relating to the subject matter itself—there are even fewer, so it is not surprising that the otherwise busy teacher has not been drawn into this phase of his science by any sense of an ample amount of readily available material. At the same time, those who have considered the matter seriously have usually become strong advocates of the value of a study of the development of science, both for its service in explaining the present status and aims of science, and also for its value as a picture of human development that probably is not to be equalled in educational value by any survey of political or military movements.

With this conviction, the present writer undertook to ascertain in just how far the history of science was being studied in American colleges and universities. Questionnaires were sent to the deans or presidents of nearly four hundred institutions throughout the United States. While such instruments are necessarily imperfect, and the individual findings perhaps often unreliable, the total mass of material thus gathered together is not without point, and it indicates among other things, that inter-

est in the history of science is far from lacking among American science teachers—that it has, in fact, developed to the point where the majority of them welcome any opportunity to urge a wider study in this field.

In only two or three institutions are conditions such that one man can devote the major portion of his time to the history of science alone, although several of the larger universities seem to be considering the establishing of such a professorship. A more usual method has been that in which a science professor has crowded in with his other courses, one dealing with the rise of his science, or has given a series of supplementary lectures along with a regular course, or perhaps, quite distinct from it. Some teachers have found it impossible to devote time to such work beyond that required for reports or occasional papers on subjects assigned to the students. But all, or nearly all, where there is evidence that they have given the matter serious thought, have agreed that here is a rich field as yet unexplored sufficiently to make clear the best method for its development, but nevertheless one which is full of material as conducive to the understanding and solution of present-day problems as any other.

HISTORY OF GENERAL SCIENCE

Very little has been accomplished by way of giving a course which might properly be called a history of general science. The reasons why such a course is probably well nigh impossible are not difficult to find. Yet, in one institution—small enough so that one man teaches the several sciences there offered —this instructor believes that he has been successful in giving a history of natural science as a whole. Such an experiment is interesting, but it should not be misinterpreted. The very fact that all of the science courses offered are necessarily more or less introductory, means that only the growth of the simpler developments can be reviewed with intelligence, and the limitation of time reduces the work to a series of excursions into the several recognized divisions of natural science. In the words of one who is himself one of the best-known American historians of certain limited phases of scientific endeavor,

> No one instructor can give a course worth giving on the History of General Science!

A somewhat better procedure—and one that will be discussed more later—is that in which by means of the collaboration of instructors in each of several sciences, it has been possible to organize a regular course or a series of extra-curriculum lectures touching ably the several branches represented. This method has the weakness of presenting the subject matter disconnectedly, and what the majority of the listeners gain will be in inverse proportion to the extent of the survey attempted. If only a very tiny bit of the lore in a given science is examined, it may be productive of some permanent mental impression. Such glimpses at several of the brighter spots in the history of the various divisions of science do not in any true sense constitute a history of science as a whole, or in parts that may be closely related. But that this method recommends itself is proven by the fact that it has been tried out several times and one of our largest universities is now considering the establishment of such a course.

Some of the colleges are offering what they designate as a history of general science, with the announced intention of making it purely introductory to a more intense study of special sciences. This practise, however, is not in accord with the general feeling of science teachers. The majority of them state frankly that they regard a knowledge of the fundamental principles of a science as absolutely prerequisite to any intelligent study of its growth. Where the rise of science is considered in a general way by the department of philosophy, it would naturally come late in the college course, and hence could scarcely serve as introductory to other undergraduate studies.

One or two colleges offer courses on the history of science extending through one semester only. Apparently this work is open to any one seeking a brief diversion from the things of the present, and while it is surely

of some value—presumably more to the instructor as the nucleus of future courses of the same type, than to the student—it must quite necessarily be regarded as one of the excursions referred to above.

Another institution gives a lecture course —one lecture a week—under the title of "Science and Scientists." This is open to freshmen and sophomores in Arts and Business Administration. It undoubtedly serves to show these young people that there have been great factors in human development other than those in which they are specializing—but it, too, is hardly of sufficient scope to be classified as a history of science.

In colleges where special attention is given to the preparation of science teachers, it has been natural to introduce into the regular courses of a more or less pedagogical nature quite a bit of historical material. And this is as it should be, for the students here in attendance are presumably somewhat familiar with the science they intend to teach, and can derive the maximum benefit from whatever historical glimpses they may be offered. If they have a real love for their subject they will fill in many of the gaps with their future reading and thus gradually acquire a measure of the historical sense in no way to be despised as a part of their scientific background.

There are a number of methods by which historical investigation and instruction may be carried into the general field of science. All have been tried with more than tolerable success. At present we can only refer to them sufficiently to indicate their approximate natures.

First, there is the public lecture course given by men belonging in the institution, or brought in for the occasion. These lectures may be in the form of a number of intimate views of a period, of the development of the science of a certain people, of the growth of a definite line of science, or each in itself may be quite complete, and otherwise wholly disconnected from the others. Whatever the form actually employed, where the speakers know their subjects, make all possible use of modern forms of illustration —lantern slides, charts, models, maps, etc.— the impressions gained by the listeners can not be other than lasting and altogether beneficial.

Where only a small amount of time can be given to the lectures each week, it is possible to carry the course through more than one year and thus cover the ground quite comprehensively. But such an arrangement usually means that attendance is optional, and without great effort it would be difficult to keep up such an interest and receptive state of mind as might obtain at the occasional lecture.

For a long time the seminar method of delving into the history of a science has been familiar. Where weekly departmental meetings are open to all who are sufficiently trained and interested to make their attendance profitable, the atmosphere of the gathering may engender real enthusiasm. It may result in an almost religious feeling towards one's beloved science, and hence, is a form of education which should be encouraged and maintained regardless of more systematic courses which may profess to cover the same ground. Subjects studied in course can not acquire the quality obtainable in the close communion of a few who have been drawn together because of a common interest in the subjects themselves, quite apart from the idea of payment in the form of credits towards graduation.

Closely connected with this sort of organization are the societies or clubs. These may range from the very elementary undergraduate groups to the postgraduate societies with or without affiliations extending to other institutions. One of the best examples of what a scientific society may accomplish was afforded recently by the Yale Chapter of the Gamma Alpha Graduate Scientific Faternity, under whose auspices a series of lectures was given. Each speaker was a leader in his line, and each covered in a brief but quite comprehensive way the historical growth of his own branch of science. Thus there were delivered, and later printed, admirable sur-

veys in the fields of mathematics, chemistry, biology, psychology, physics, geology and astronomy. Naturally, these were not of a type suitable for elementary presentation.

One institution—a college of engineering —gives a two-hour course on the history of science to all sophomores. In another, two courses have apparently gradually merged into one. For many years a course dealing with the history of the inductive sciences had been offered by the professor of biology. Later he was joined by the professor of mathematics, and between them they rounded out the course into a fair approximation of a general history of science, or more correctly, a brief history of several associated branches of science. The usual limitation of time made it impossible for them to cover everything, and so, *e.g.*, the history of chemistry was handled independently by the professor in that department. The lecture notes of the two men thus associated finally reached such proportions that they were printed, and now form a well-known elementary text on the subject. According to one of the authors, the real object in putting the material into book form was to lessen the dependence of the students on the lectures. As originally worked out, the time was divided about equally between the two instructors, the mathematician covering most of the Greek period, and mathematical science previous to the calculus of Newton. The biologist has traced the development of modern science and the special phases of the entire review with which he was most familiar. Each student is supplied with blank forms for his reports on collateral reading of biographies and other historical subjects in connection with the course. Essays are required, for it has been the feeling of the instructors that nothing short of this written work secures a sufficiently intensive study of the assigned reading matter. The two parts of the course may be taken independently, and although the work has been elementary enough to make no definite prescription of preliminary scientific work necessary, it has quite naturally been found that "some degree of scientific background and some maturity are desirable."

This method of procedure has been discussed here somewhat in detail because it shows very admirably what may be accomplished by pioneers. However inadequate such courses may seem, they are of the type that may be organized in almost any college if there is but time. The form of cooperation will depend on the men and material available.

A well-known college for women has found some value to be obtainable in a collateral reading course which is carried on privately throughout two years. In still another college, the cooperative method referred to above has proven quite successful. Apparently, the department of philosophy gives two lectures a week on "Life Views of Great Men of Science." At first this would seem like a rather large responsibility for such a department to assume, but the college catalogue shows that associated with the instructors in philosophy—one of whom is the president of the institution—are men from the departments of astronomy, geology, chemistry, mathematics, physics, anatomy, physiology, zoology, economics and sociology. Such wide cooperation, while not free from some of the objections made above, is most gratifying and must make not only for good feeling between the several departments, but serve the students as material evidence that each so-called science is only one phase of a great body of truth—that its various developments are all aspects of one growth.

In one of the greater universities, two associated courses are given, one a "History of Science from the Physical Standpoint," and the other, a "History of Science from the Biological Standpoint." The lecturer in each case occupies a prominent place in his chosen field. Undoubtedly, these courses are primarily historical reviews of physics and of biology, respectively, and should be classed with the rather narrow histories of specific sciences to be considered later.

In another university there has for some time been given a composite course dealing

with biology and physics. The lecturer himself is a physiological chemist, and would be expected to take the experimental viewpoint. Such a combination of these subjects is quite natural when one considers the parallel steps in their development. For example, how closely were they connected in the early work of the Royal Society, and how evidently is the apparatus of modern biology borrowed from the physical laboratory! In this same institution a special lecturer has dealt with specific phases of the history of science, and also written much, advocating its wider study. His method seems to be that of following the growth of an idea and the philosophy involved. Both methods of approach are proper and will undoubtedly leave their separate imprints on the later forms in which the history of science will be handled.

One further arrangement for approaching this subject in a general way may be mentioned, although the course referred to is not offered primarily as a history of science. At a certain college a general culture course has recently been organized under the all-embracing title of "Evolution." The fact that it is given by the department of biology might lead one to expect the usual restricted meaning of the term. However, in the words of one of the instructors responsible for its direction,

> It is a composite course that covers so wide a field that the bare facts are emphasized rather than historical development, although the latter is by no means ignored. Fundamental chemical and physical principles are given without any historical setting, but the lectures on astronomy necessarily take up the historical side, especially in the development of evolutionary theories. The same may be said for the biological lectures where we cut out all possible detail yet give a skeleton outline of the contributions of the more celebrated men to the theories of organic evolution. The course ends with a review of the present known facts regarding the organic development of man himself while a certain amount of time is given to social and mental growth (culture).

As this course itself is still in the early stages of its evolution, its real value can not as yet be ascertained, but it is not impossible that it, too, may serve as one of the pioneer attempts that will form the basis for the future courses on the history of science.

HISTORY OF SPECIFIC SCIENCES

There are many evidences that much more success has been obtained in the shaping and conducting of courses on the history of the specific sciences than where the whole field of science has been engaged in a single campaign. Here the difficulties to be met by the lecturer in crossing the boundary between two branches of science are largely avoided, and although the interrelation of the several sciences can not be lost sight of, his natural limitations do not prevent him from presenting the history of his specialty in a manner that is sufficiently connected to lead to logical conclusions. He is able—by limiting his attention to a single field of development—to secure a picture so complete as to impress the student's mind with the one fact of paramount importance, namely, that he is reviewing a growth, one that never goes backward, and one which in its latest stage—the present—is an integral part of the world as he now sees it. Such a study, to be of greatest worth, is, of course, suitable for advanced students only in the particular science to which it relates. Here is an unquestionable case in which the advocates of prerequisite scientific training are thoroughly sound. The field is not new. Enough has been written to make great blunders no longer unavoidable, and many such courses are at present being offered in American colleges, though so far their usefulness has been limited by the lack of time on the part of the teachers and the failure of others to appreciate the value in such things in this age of seeking after immediate practical results.

Naturally, mathematics is one of the leading subjects whose history is now being taught as an independent course. The maturer the student and the wider his knowledge of the methods of mathematics, the greater will be his pleasure and benefit from a review of the philosophy and labors that have developed the powerful mathematics of the present. In some institutions it has been possible to combine something

of the history of mathematics with a course on the methods of teaching mathematics. Then, too, there are the usual variations—special lectures in connection with or supplementary to the regular mathematical courses, seminar work, etc. Closely associated with historical studies in pure mathematics are those, such as the histories of astronomy, civil engineering, analytical mechanics, and mathematical physics.

Where the history of a special science is handled by a member of the department of instruction devoted to that science alone, the viewpoint of the scientist, *i.e.*, the viewpoint of the original investigator and discoverer whose work is being studied, may be presented. The physical equipment within the department affords not only a convenient but absolutely essential means of illustration. In many cases, this may and should involve the actual repetition, step by step, of the classical experiment or investigation. All possible pertinent material should be acquired for its usefulness in this particular course, and that this can be handled to the best advantage only by the specialist, goes without saying.

At present there are offered in this country courses dealing solely with the histories of mathematics, physics, chemistry, biology, zoology, botany, evolution, anthropology, astronomy, geology, psychology, medicine, pharmacy, home economics, engineering, and probably many others. In some cases there are evidences that these subjects have been offered because of the vision of a single man who not only launched the work, but maintained it personally. That this has often been so is shown by the fact that the course has been allowed to lapse after the departure of this particular teacher. Those who remain are kept too busy to carry on the work, although the majority of them have expressed the firmest conviction of its worth.

The historical courses in these main divisions of science are modeled differently in various institutions. A few attempt to cover the entire history of the subject chronologically. In other cases the material is taken up by periods, *e.g.*, the "Development of Chemistry During the Seventeenth Century." Or again, a very narrow line of growth within the science may constitute the subject matter of the course, such as the "History of the Law of Gravity." Either of these latter methods, though limited in scope, makes possible quite thorough work.

The present high development of the sciences is a thing of such modern times that there is no end of material available for studying the recent portions of their growth. Here again is a task that must be directed by the specialist—one who is familiar with the literature of his science. Probably no physicist would consider himself capable of directing the historical reading and research in the field of botany. Likewise each science teacher would view as puerile the attempts of any one—no matter how capable in a special field—to direct all of the various phases in a course on the history of general science.

From time to time eminent chemistry teachers have conducted lecture courses on the chemistry of a period or the evolution of a chemical theory, although in many cases such instruction is no longer given. Probably this is because the present-day specialist finds little time for such studies in addition to the purely technical work for which he is most admired just at present.

One institution gives each beginning class in chemistry five lectures dealing solely with historical matter. Of course, in all schools some of the history of the subject is introduced from time to time in the regular instruction in the science. Some teachers of long experience have expressed themselves as greatly in favor of giving more time to this history—a special course, if possible—but owing to the difficulty in setting apart the requisite amount of time for such a thorough study, they have had to content themselves with mere references to the historical background. However, this method in any science is not without its good points, for it is one of the surest ways of securing interest, and at the same time it prevents the student from grasping a law or serviceable result as a God-given tool and the only feature worth retaining. It shows him the essentially hu-

man quality that lies under and behind all progress—that all progress is at the expense of human endeavor. And is not this one of the prime objects of education?

The history of physics is only beginning to be fully appreciated. In one of the eastern universities, courses were conducted for a time by the head of the physics department, in which he sought to present "not only the material that can be found in some of the books upon the subject, but also traced the development of certain fundamental fields." He employed the lecture method. His success and possibly the reason why the work was not continued after his departure from the institution, are explained in part by the remark of one of his colleagues.

> Professor ——— himself was able to add the personal touch of experience in the historical development in many phases of the work in physics.

This, of course, is a brief statement of the ideal qualifications of the director of any course in the history of science.

Often brief courses on special historical subjects, or rapid surveys of a large portion of the growth of a science are opened to prospective teachers. Such work—where the students are well grounded in their subject and where the widest possible use is made of the departmental library—is probably of no small value, if for no other reason than that by enriching the coming teacher's outlook, it will make better the instruction of the next generation.

Where time is limited, a course may be offered, say, once in three years, or the departmental society or club may be pushed into really serious activity. Even extension courses are worth while if the students are themselves teaching and have some library and laboratory facilities at their own disposal. Such work may be closely allied with regular graduate work in the same field.

A suggestion as to how a course may be composed of biographical studies, as well as of a review of purely technical developments, may be gained from the statement that the study of the history of botany in one of the greater universities has "included not only the evolution of the science, but the lives and contributions of leading botanists, the history of the microscope, etc."

METHOD OF PRESENTATION

The formation of a course in the history of any branch of science has, in the majority of cases, waited for the appearance of some sort of book that might serve as a text. Few instructors have had the time or the courage to plunge into such a course dependent only on their own lecture material and the assignments of collateral reading. No matter how desirable it may be that the teacher should be thoroughly capable of writing his own text, energy and opportunity are seldom available for such an accomplishment.

Almost with one accord, the teachers who have responded to the present inquiry have voiced this need for text-books, for there is very little in English that may be so used. Note that the cry is not because of a lack of original source material for reference or research work, but for suitable secondary sources that present the material in a form sufficiently well chosen and digested to be usable by the beginner and constitute a skeleton about which a course may be built up. This seems to be true even in the cases of those sciences of which one or two quite admirable histories are now available. In addition, little is to be found in book form covering the developments of the last decade or so. Of the few history texts available, there is almost no choice. They are necessarily the same works as used elsewhere and in former courses. For obvious reasons they can not be listed here, but their number is so small that every science teacher probably has on his own desk all that is obtainable for his use at the present time.

These few books are usually the outgrowths of lectures given when there were no texts at all. The years that have elapsed since their publication have put them out of touch with modern advances, although this is a fault which may usually be overcome by the use of references to current literature during the latter days of the courses in which they are used. It is perhaps not surprising that teachers have

been quite harsh in their criticisms, but it is to be hoped that their distress is sufficiently real to drive them to the point of writing something better, for here is one of the few fields in which there are not too many books.

Where a course has been limited to the study of the growth of a theory or of a particular branch of the science, some useful books have usually been available. Single works dealing with the progress of a given era are much scarcer, and, as already suggested, satisfactory works covering the entire growth of the subject are rare indeed. The natural compromise that has resulted is a combination of the lecture and text-book method. To date this form seems to have had the widest trial. Instead of depending upon one book only, the library facilities may be drawn on so as to make use of many authors in addition to the lecture notes. Papers on these outside readings insure a fair degree of application in their use. One teacher employs the lecture method mainly and assigns to the students biographical topics only. In another institution, where several courses in the history of science are given, a text-book in one of them serves as the nucleus about which the course centers, but the class discussion is devoted mainly to points in a set of over four hundred typewritten questions supplied by the instructor. There are also reports on outside reading. In the psychology classes, finding no book suitable, the lecture method has been employed almost entirely. The same is true in the history of pharmacy, but also for the additional reason that at the time of the report the class had over one hundred and twenty members. In medicine, at this institution, the lecture method is supplemented by an assigned paper on a historical subject to be chosen by the student himself.

In connection with this question of the form of presentation of the subject, it is interesting to note the method employed by one instructor in chemistry. He wrote:

> I let the class decide which style they prefer. If they are preparing to teach chemistry, they seem to prefer a text-book, otherwise they choose the lectures.

He says nothing about any difficulty in getting the members of the class to agree.

Another method, and when it can be carried out consistently, the one most in keeping with the fact that any historical study should be an attempt to see for one's self as clearly as possible just what has transpired, and what were the immediate causes contributory to the various progressive steps in the growth of the science, is that where the lecture method is combined with the reading of original sources. Many a small college library contains much material that may be used in this manner, *e.g.*, the *Philosophical Transactions*, and the scientific journals that have been published during the past century. Reprints of older sources are now available on quite a number of subjects, and fragments of original papers are often to be found in encyclopædia articles and elsewhere, so that with diligent searching the instructor will usually be able to make a beginning, and he may be surprised at the wealth of material close at hand.

The type of material obtainable from current periodicals is too familiar to need discussion here. *The Readers' Guide* will indicate the main papers of the essay type which may be found in popular magazines and which are serviceable in a course on the history of science. Where complete files of the older technical journals are available, they will naturally be put to almost constant use, although in one institution now offering such a course it is declared that there are "none used." In another, the instructor in the history of chemistry refers his pupils to "the best known chemical journals, especially for their obituary notices." Undoubtedly still other features of interest may be found.

Where the students are sufficiently advanced and equipped to handle foreign languages, their investigations are greatly facilitated, for aside from possibly a single periodical in English dealing exclusively with the history of science, there are several of this type in Europe.

One question that arises quite naturally in the projection of a course on the history of science, is whether it shall be of the "cul-

tural" type and perhaps open to the majority of students, or of the sort suitable only for those who have already begun specialization. These are, of course, quite different propositions, but the consensus of opinion is that the latter type—where the student has at least had a fair introduction to the subject—is the one capable of the greatest good. In one instance, a historical study of chemistry and zoology is regarded as a "general cultural course offered to all students who have the scientific background which would enable them to carry the work intelligently." Another institution opens its course on the history of chemistry to all students, "but prerequisites are insisted upon." Some schools simply require that applicants shall have had one full year in the science. Others allow any students within the institution to attempt the work if they wish to, but insist that it be taken by all who are majoring in the department. A geology instructor says that "good training in geology is prerequisite to history of geology"—a requirement which is not very definite. Though one teacher—a chemist—considers his history a purely cultural course, he admits only those who have had some work in organic chemistry in addition to the general courses. Another instructor has a different vision. He hopes that the course which is now open only to students working in his department, will ultimately become a cultural one and open to everyone. At one college giving a history course it is claimed that "the lecturer has maintained a certain standard by assuring himself that each student has taken courses in the biological as well as the physical sciences." The department of chemistry in one of the western universities is in a position to offer a strong course on the history of science from the fact that it admits to this class only "graduate and upper class students in chemistry with extensive prerequisites, including French, German, advanced mathematics, and physics—general courses."

These brief references show that in many institutions it is now possible for those students who are specializing to obtain courses on the history of their subject.

PUBLICATIONS BY PRESENT TEACHERS OF THE HISTORY OF SCIENCE

The administrators to whom the present inquiry was directed were asked to supply lists of the papers and books dealing in any way with the history of science and written by members of their instructional staffs. The results obtained are probably in no way a fair indication of what has been accomplished, for aside from the few well-known books already referred to, apparently only a little has been done, even including thesis work, popular biographical sketches, bibliographies, and unpublished papers which have been read before local or possibly state scientific societies.

CONCLUSION

It has been a pleasure to read the comments and suggestions of those who have so generously assisted in the present inquiry. Many of these ideas have been embodied in earlier parts of this paper. By far the majority of the letters received are strongly in favor of pushing the history of science to the position of a regular feature of the curriculum. In some schools the faculty is too small to add any subject whatever to the course of study. In such institutions, it is not unusual that the mathematics professor would be glad to offer a course on the history of mathematics. A physics teacher "would like to see such a course in physics offered, but lack of time makes it impossible at present." In spite of the historical material which every science lecturer now and then introduces into his courses, one of them writes: "most of our students know very little about the history of science. Much more attention should be given to this subject." A professor of chemistry thinks "it very advisable to give a short history of the development of chemistry. Will do it when it can be squeezed in." This indicates the general difficulty.

A college dean, as if sensible of inexcusable negligence, hastens to remark:

We realize the value of this subject as an integral part of a progressive curriculum and we shall in due time organize such a course.

Similar expressions are too numerous to quote here.

A need for such a course is arising.

Of great importance!

I am glad to see interest in this important subject is developing widely.

There is without doubt a place for such courses. . . . I should like to see here and elsewhere a "general cultural" course in these subjects offered. This would be of vast interest to B.A. students who would not be attracted by the more thoroughly scientific courses. (The word "scientific" is probably used here to mean "technical.")

The president of a certain engineering school would not favor any deviation from a rigorous technical presentation of the subject, for he believes "that all subjects are cultural if properly taught and so placed before the students." An eminent chemist has the satisfaction of feeling that his history lectures are "proving helpful to prospective chemistry teachers."

A physics instructor in a prominent university writes:

The history of science, either in its general aspect or in specific fields, is an interesting and valuable part of science training, but it is extremely important that the presentation of such work be such as will arouse interest and give the perspective that will enable the student of science to better understand the order in which facts and theories have developed. Such an understanding of the past will help the student in getting a clear idea of exactly where the boundary line between experimental fact and theory lies. I feel that this vitalizing purpose is essential to the success of such work.

A number of administrators have written that the matter of establishing one or more courses in the history of science is already under discussion. Where the idea is new, a few have questioned the possibility or appropriateness of such a course, but the wide success elsewhere serves amply to answer such objections. For example, a leading university president has expressed some of the difficulties of the situation with remarkable comprehensiveness, and were it not for this fact that very successful arrangements have been developed on a number of lines throughout the country, his statement of the problem would be quite discouraging. It is, however, worthy of attention.

Two distinct types of courses are possible, and appeal to two distinct groups of students: (1) General courses requiring but a moderate amount of technical knowledge on the part of either instructor or students. (2) More specialized courses given by experts in single branches of science for students who are somewhat acquainted with the science in question. No combination of the two types seems to me possible. Even if a sufficiently polymathic instructor could be found, no group of unspecialized students could follow him, and no group even of specialized students outside their own specialties.

A joint course by the representatives of the several different sciences could, of course, be organized, but could not go far without getting away from the class.

The problem is a hard one.

And yet, like other hard problems, it is meeting with partial solution in many quarters.

In this investigation the data obtained can not be thrown into the form of definite numerical values, for several quite evident reasons. The questionnaire method of gaining information has its own natural weaknesses. All who answer are more or less prejudiced. Some may show an interest that is by no means real, or they may give the answer that they believe will sound best as coming from their institution. Furthermore, no weight has been assigned to the courses considered in terms of the number of semester-hours covered. The size of an institution is not taken into account, nor the number of instructors and students in the science departments. Sometimes deans or presidents have answered questions in a general way that could be handled better by the men in science, and one science instructor has usually replied for all of the science departments. Hence, the replies have not always been as representative as could be desired. Departments given over entirely to experimental

research and instruction naturally have not developed courses from the historical side, although the individual instructors may be quite well versed in the subject. Then again, the answers received indicate that even among these men the distinction between so-called "popular" science and fundamental science is by no means clear.

Lest offence be taken by teachers of political and social history, it should be emphasized that no consideration has been given here to their admirable work in tracing the development of human thought and of their growing appreciation of the influence of scientific progress on all history. Their cooperation is needed at every turn—in developing the special methods of historical research suitable for scientific work—in creating a greater demand for such history, and in producing the literature which may satisfy the new needs.

The various suggestions here made are given for what they are worth. Few points of procedure have been indicated as wholly preferable. They are all the testimony of the men and women whose vision has led them into the struggle to add this true side of history—and of science—to those already in the schools, for it is human history, as well as history of science.

My sincere thanks are extended to all who have submitted their views on any phases of this question. Certain aspects of the investigation will constitute material for reports elsewhere.

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THE EXPEDITION TO TRINIDAD FOR THE STUDY OF HOOKWORM DISEASE[1]

AN expedition for the study of the life of hookworm eggs and larvæ in the soil was sent out by the department of medical zoology of the School of Hygiene and Public Health of the Johns Hopkins University to carry on investigations in Trinidad, British West Indies, during the summer of 1921. The expenses of the expedition were paid by the International Health Board of the Rockefeller Foundation. The International Health Board through the Trinidad Ankylostomiasis Commission and the Trinidad government cooperated with work of the expedition. The party from the United States sailed from New York on May 5 and returned on September 17. The expedition was under the direction of Dr. William W. Cort of Johns Hopkins University, and worked in cooperation with Dr. George C. Payne, the director for Trinidad of the International Health Board, who also took an active part in the investigations. The others who took part in the investigations were Dr. James E. Ackert, of the Kansas State Agricultural College, Dr. Florence King Payne, of Trinidad, and Mr. Donald L. Augustine, of Johns Hopkins University. Much of the scientific equipment was shipped from the United States and some was borrowed from the Trinidad Ankylostomiasis Commission. The work was carried out at Princes Town, which is in the south central part of the island, in an area where sugar-cane cultivation predominates. Over seventy per cent. of the people of this region are infested with hookworms. This high incidence of hookworm disease and the close coordination with the control campaign served to suggest problems for work and to give an abundance of material. A private residence was rented for a laboratory and fitted out with the necessary equipment. A large space under this house was utilized for animal pens and laboratory space. The yard surrounding the house was also used in a number of the outdoor experiments.

The investigations of the Trinidad expedition were centered around the study of the phase of the life of the hookworm which is passed outside the human body. An effective attack on the problems of the life of the larvæ in the soil was made possible by the utilization of an apparatus invented by Baermann, which makes it possible to iso-

[1] A full account of the results of the work of this expedition will appear in a series of articles in the *American Journal of Hygiene*.

late the larvæ from considerable quantities of soil. Both field and laboratory studies were included in the program. The field investigations consisted of intensive epidemiologic studies of the factors involved in the spread of hookworm disease in two limited areas, one on a sugar estate and the other on a cacao estate. The laboratory investigations included a study of the following points, viz.: (1) the relation of the chicken and pig to the spread of hookworm disease, (2) some of the factors influencing the hatching of the eggs, (3) the migrations both vertical and lateral of the infective hookworm larvæ and (4) the length of life of the infective hookworm larvæ.

A summary of the most important results obtained will be given here.[2]

1. Sources of Human Infestation

In the two field areas studied a comparison of the distribution of soil infestation and the habits of the people revealed that almost the exclusive sources of human infestation in these two areas were the places in a cane field and a cacao grove which were constantly visited for the purpose of defecation.

2. Reduction of Soil Pollution by the Introduction of Latrines and an Educational Campaign

It was found by a study of the distribution of soil pollution in the cane area that the building of an adequate number of latrines and the carrying through of the regular educational campaign against hookworm disease resulted in a very great reduction of soil pollution in a period of about three weeks.

3. Relation Between the Distribution of Soil Pollution and Soil Infestation

In both the cane and cacao areas gross soil pollution by infested individuals did not always produce soil infestation, especially in unprotected places near houses, latrines or at the edge of the cane field. The conclusion was drawn that in the heavy clay loam soil of these areas the conditions are unfavorable for the development or continued life of the hookworm larvæ, unless there is protection by shade and vegetation.

4. The Relation of Chickens to the Spread of Hookworm Disease

When chickens ingested human feces containing hookworm eggs only a very small percentage of such eggs produced infective hookworm larvæ. Chickens fed on human feces containing hookworm eggs were found to produce limited areas of soil infestation at their drinking places, or under their roosts. The conclusion is drawn, however, that in view of the great reduction of infective larvæ produced by passage through the chickens, they are, under the conditions in Trinidad, a factor favorable rather than unfavorable to hookworm control.

5. The Relation of the Pig to the Spread of Hookworm Larvæ

Eggs of the human hookworm which had passed through the digestive tract of the pig developed as readily in pig as in human feces, thus making pigs a factor in the dissemination of hookworm larvæ whenever they have the opportunity of ingesting human feces containing hookworm eggs. In connection with this work a new species of *Necator* closely resembling *Necator americanus* was found to be prevalent in the pigs in Trinidad, and its morphology and distribution studied.

[2] These results are taken from the work of all the members of the expedition. The epidemiologic studies in the field were made by Doctors Cort and G. C. Payne. The work on the relations of the chickens and pigs to the spread of hookworm disease and on the conditions influencing the hatching of hookworm eggs was done by Dr. Ackert. Drs. Florence K. Payne and Ackert collaborated on the work on the new species of pig hookworm from Trinidad, and Dr. Florence K. Payne made the studies on vertical migrations of the infective hookworm larvæ. The laboratory experiments on the horizontal migrations and length of life of the infective hookworm larvæ were made by Mr. Augustine.

6. CONDITIONS INFLUENCING THE HATCHING OF HOOKWORM EGGS

Hookworm eggs hatch as readily in ashes as in soil. Hookworm eggs in feces buried to a depth of from 1/2 of an inch to 2 inches hatch and the larvæ develop in numbers, there being only a slight retardation in development. When eggs were buried from 4 to 5 1/2 inches in a clay loam soil, only a few larvæ were able to develop. The invasion of the stools by numbers of fly larvæ was found to be detrimental to the development of hookworm larvæ to the infective stage.

7. THE FINDING OF UNSHEATHED HOOKWORM LARVÆ IN THE SOIL

The finding, both in field and laboratory studies, of a large percentage of mature hookworm larvæ without their protective sheaths, led to the conclusion that a large proportion of such larvæ in the soil complete their second larval moult and continue to live in the unsheathed condition.

8. VERTICAL MIGRATIONS OF INFECTIVE HOOKWORM LARVÆ

It was found that under certain conditions mature hookworm larvæ when buried to a depth as great as 5 1/2 inches can migrate to the surface. In such a migration the larvæ used up most of their reserve food supply, so that after reaching the surface they were relatively inactive and the cells of the intestine had become almost transparent.

9. HORIZONTAL MIGRATIONS OF INFECTIVE HOOKWORM LARVÆ

From laboratory experiments and field observations it was found that mature hookworm larvæ do not migrate actively from their place of development, although they may be carried to considerable distances by the action of water or on the feet of man. These observations showed that the present idea that the soil of considerable areas can be infested by the migrations of the larvæ from limited centers is untenable.

10. LENGTH OF LIFE OF INFECTIVE HOOKWORM LARVÆ IN THE SOIL

Under the conditions in Trinidad the length of life of infective hookworm larvæ in the soil is short, almost never exceeding six or seven weeks. In an area of a cane field where there was intense soil infestation there was a reduction of over 90 per cent. in the numbers of larvæ in about three weeks after the practical elimination of soil pollution. After six weeks only a very few larvæ were left. In a large series of laboratory experiments carried out with different soils and under different conditions, there was a great reduction in numbers of larvæ after from two to three weeks and an almost complete dying out in six weeks. These findings which are contrary to the present conception of the length of life of infective hookworm larvæ indicate that under tropical conditions, the larvæ will die out quickly in the soil after the elimination of soil pollution by infested individuals.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE: THE TORONTO MEETING

The second Toronto meeting of the American Association and associated societies will be very conveniently arranged in all its details and promises to be one of the most satisfactory meetings in the history of the Association. The preliminary announcement of the meeting has recently been sent from the Washington office to all members, and the permanent secretary will send copies to all who request them.

The announcement, a 47-page booklet, gives the personnel of the local committee for the meeting (Dr. J. C. Fields, chairman; 198 College St., Toronto) and the list of the chairmen of the twelve subcommittees that have charge of local details, also the list of the Toronto representatives of the various sections. Many features of the meeting are mentioned or described. The usual lists of

officers and committees are included, together with a complete list of the associated societies.

Its international character will be an important feature of this meeting; it is not often that the association meets outside of the United States.

As has been announced in SCIENCE, railway rates of a fare and a half for the round trop (on the certificate plan) will be available to those attending. The announcement gives detailed instructions for securing these reduced rates. Every one going to the meeting should secure a certificate when he purchases his going ticket, even though he does not wish to take advantage of the special fares, and all holders of certificates (or round-trip tickets from the far west, outside of the region of reduced rates) should record them at the registration room immediately upon arrival. To secure the privilege of lower fares there must be at least 350 certificates and round-trip tickets (counted together).

The Toronto meeting will be especially convenient and otherwise enjoyable by reason of the special lodging and dining arrangements that have been made by the local committee and its subcommittees. Those in attendance are to be housed in the dormitories of the University of Toronto, and meals will be served in the university dining halls. The meeting places of the sections and societies will be in the university buildings, and only a short walk will be necessary to reach them from the dormitories and dining halls. A uniform rate of $3 a day will be charged, including meals. The announcement contains the usual table showing hotel rates, but those attending the meeting are urged to take advantage of the rooms and meals provided at the university. To engage rooms, address Professor J. M. D. Olmstead, chairman of the subcommittee on dormitories, 198 College St., Toronto.

There will be an exhibition of scientific apparatus and products. Those wishing to exhibit should address Professor E. F. Burton, chairman of the Subcommittee of Exhibits, 198 College St., Toronto.

The publicity arrangements for the Toronto meeting promise to be exceptionally good. This work is in charge of the Subcommittee on Publicity, with the cooperation of Science Service, of Washington, D. C. Material for newspaper publication, or abstracts, etc., that may be used as a basis for newspaper notes, should be sent until December 24, to Dr. E. E. Slosson, editor of Science Service, 1701 Massachusetts Avenue, Washington, D. C. After the date just mentioned they should be sent to Professor A. G. Huntsman, chairman of the subcommittee on publicity, 198 College St., Toronto,—or handed in at the publicity office near the registration room. Those planning to give papers or addresses at the meeting are urged to send accounts to Dr. Slosson in advance.

An exhibit of educational motion pictures on scientific subjects is arranged for Tuesday afternoon, December 27, the pictures being furnished by the Visual Education Association.

The meeting will open on Tuesday evening, under the presidency of Professor E. H. Moore, of the University of Chicago. At this time the retiring president, Dr. L. O. Howard, of the U. S. Department of Agriculture, will give his presidential address. A reception will follow the opening session.

On Wednesday afternoon, December 28, there will be a reception in the Royal Ontario Museum.

The Wednesday evening session will be occupied by a lecture given by Professor William Bateson, director of the John Innes Horticultural Institution, Merton Park, Surrey, England. This eminent British scientist is to attend the Toronto meeting under the joint auspices of the American Association and the American Society of Zoologists.

On Thursday afternoon, December 29, Sir Adam Beck, chairman of the hydro-electric commission of Ontario, will deliver a lecture, with motion pictures, on hydro-electric developments in Ontario.

Thursday evening will be devoted to a

general conversazione in Hart House, to which all members of the association and associated societies are invited. Many of the athletic activities of Hart House may be seen, such as boxing, diving, water polo and indoor base-ball. There will be band music and bag-pipe music, and a concert in the music room. A program will be staged in the Hart House theater. Refreshments will be served in the Great Dining Hall of Hart House. Hart House will be open to visitors also on the evenings of Tuesday, Wednesday and Friday.

An exhibit of artistic skating by the Toronto Skating Club, followed by an ice-hockey match, will be given, under cover, on Friday afternoon. All in attendance at the meeting are invited.

The general program of the Toronto meeting, including programs for the sections and for the twenty-one associated societies meeting with the association at Toronto, will be ready for distribution on Tuesday, December 27, at the registration room.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC EVENTS

FOREST EXPERIMENT STATIONS

A RECENT circular by the Forest Service of the Department of Agriculture, entitled "Forest Experiment Stations," outlines what forest experiment stations have done, what they need to do, why they are needed, where they are needed, and what they would cost.

Six stations were established in the West between 1908 and 1913, with a small technical staff at each. In spite of limitations in funds and personnel valuable results have been secured in showing how to plant the Nebraska sand hills, in planting on the western National Forests, in the development of methods of cutting Douglas fir forests, in a study of the relation between forests and streamflow, and many other questions.

The field of forest experiment stations includes forest botany; forest distribution; forestation, from the production, collection, extraction, cleaning, testing and storage of seed, to nursery practise, direct seeding and field planting; silviculture; forest protection; utilization of products, such as naval stores and forage; forest management, or the regulation of the cut with its basis of data on volume, growth, and yield; the effect of forests on streamflow, erosion, and climate; and, underlying these, studies of the fundamental natural laws governing tree growth and the life histories of the individual species and types.

To meet present forestry needs, a program is outlined which includes ten forest experiment stations, each with a technical staff of from 6 to 12 men, and distributed, 5 in the East, 3 in the Rocky Mountains, and 2 on the Pacific Coast. Specifically, they would cover the Southern Pine belt in the Atlantic and Gulf States, the Lake States, the Northeast, including New England and New York, the Allegheny region, the Southern Appalachian Mountain region, the northern, central, and southern parts of the Rocky Mountain system, and the northern and southern parts of the Pacific Coast region.

THE U. S. PATENT OFFICE

WHEN Commissioner Newton was in charge of the Patent Office in July, 1919, he testified before a committee of Congress to the effect that the situation in his bureau was deplorable and that it was in a worse condition at that time than at any other time since he had been in service. His service began in 1891. The present commissioner of patents in his report to the Congress points out that the degeneration has continued steadily since the testimony of Commissioner Newton was given. Between July, 1919, and June 30, 1921, the Patent Office lost 163 of its examiners. The report states that

> These men were scientifically trained and also members of the bar. They have been replaced by inexperienced men, fresh from college, without any knowledge of patent law and without legal training.
>
> During the time the Patent Office has been losing the 163 men aforesaid, the number of applica-

tions received in this office has increased by leaps and bounds. The number of applications for patents has increased 34 per cent. during the period under discussion, while the trade-mark applications increased eighty-five and a half per cent. In July, 1919, when Commissioner Newton testified, there were 18,000 patent applications awaiting action. There are now about 50,000 applications awaiting examination. It is further shown that a number of divisions are over 11 months behind in their work, and to illustrate the large turnover in the personnel there is cited one of the chemical divisions where five out of the nine examiners have been appointed in the last few months. At the close of the fiscal year, one of these had been in the office only 1 week, another 3 weeks, another 7 weeks and another 2 months. One out of every four examiners has resigned in 16 months and more than half have resigned in 32 months. Relief is, therefore, imperative.

Reference is made to the entrance salaries of the assistant examiners, who are a highly educated and picked corps of scientific men, who receive the same initial salary as clerks who perform routine duties in other branches of the government service. Note is made of the inadequacy of the salaries paid to these technical men as compared to their qualifications and the requirements of their position, showing the necessity of correcting the disparity of conditions.

The receipts of money for the fiscal year just closed increased from $2,615,297.33 of the previous fiscal year to $2,712,119.69, or almost $100,000. A net surplus of $284,342.93 was earned and if the bonus be subtracted therefrom, the surplus amounted to $71,743.73, making the total net surplus to date—that is, the excess of receipts over expenditures during the history of the Patent Office —$8,376,769.92.

SCIENTIFIC JOURNALS PUBLISHED BY THE GOVERNMENT

Practically all the technical and scientific periodicals which the Government is issuing have been suspended. These include the *Journal of Agricultural Research* and the *Experiment Station Record,* issued by the Department of Agriculture.

The matter goes back two years or more to a time when Senator Smoot secured the adoption of a resolution terminating the issue within a specified period of all periodicals not authorized by the Congress. Hearings were held and assurance was given that the committee was not concerned with scientific journals, but was particularly interested in certain war-time periodicals which had sprung up. The time for action was extended once or twice, and, as the committee had failed to decide what should and what should not be printed, an item was inserted in the Sundry Civil Bill last March, extending the time to December 1, 1921, and providing that such publications as were not approved prior to that time should be discontinued.

Near the close of the last Congress, Senator Moses, the present chairman of the joint committee on printing, secured the passage of a measure in the Senate placing the matter of continuance or discontinuance in the hands of the joint committee on printing. The resolution went to the House in the closing days of the session, where it was amended by the House committee to provide for a further extension of time to March 1, 1922, in order that the committee might have further time for consideration. No action was taken on the resolution and the periodicals in question ceased publication with December 1. The latest proposal is not to give any further authorization for the continuance of any of them. Discussion of the matter will be found in the *Congressional Record* for December 7.

THE AMERICAN SOCIETY OF ZOOLOGISTS

The Toronto meeting of the American Society of Zoologists will convene on Wednesday, December 28, in the biological building of the University of Toronto. The sessions will continue until Friday night. The program of contributed papers numbers 109, the largest in the history of the society. The tentative program follows:

WEDNESDAY, DECEMBER 28

A.M.

Section A. Embryology, Cytology and Comparative Anatomy.

Section B. Genetics.

P.M.

Genetics.

Evening

Professor William Bateson's address before the American Association, followed by the Biological Smoker at Hart House. Members of all biological societies are invited to attend.

THURSDAY, DECEMBER 29

A.M.

Joint meeting with Ecological Society of America.

P.M.

Section A. Parasitology.

Section B. General and Comparative Physiology.

FRIDAY, DECEMBER 30

A.M.

Business session.
Section A. Parasitology.
Section B. Genetics.
Inspection of Exhibits.

P.M.

Symposium on Orthogenesis: L. J. Henderson, C. B. Lipman, M. F. Guyer, William Bateson, and H. F. Osborn, with discussions by Oscar Riddle, J. G. Fitzgerald and J. C. Merriam.

Evening

Annual Zoology Dinner, followed by address by William Bateson, "The Outlook in Genetics." Members of all biological societies are invited to attend.

W. C. ALLEE,
Secretary-Treasurer

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM BATESON, director of the John Innes Horticultural Institute, who will be present at the convocation week meeting at Toronto as the guest of the American Association for the Advancement of Science and the American Society of Zoologists, will give a public address on "The Evolutionary Faith and Modern Doubt." At the dinner of the Zoologists he will speak on "The Outlook in Genetics."

THE nomination of Dr. Walter B. Cannon, Harvard Medical School, to serve in the Medical Reserve Corps of the U. S. Army, with the rank of brigadier general, has been confirmed by the Congress.

HENRY HOWARD was elected president of the American Institute of Chemical Engineers at the convention held in Baltimore recently.

YANDELL HENDERSON, professor of applied physiology, graduate school, Yale University, has been elected a corresponding member of the Society of Physicians of Vienna.

SIR FRANK DYSON, astronomer royal, has been elected master of the Clockmakers' Company.

AT the inaugural meeting of the 168th session of the Royal Society of Arts held on November 2, the society's medal was presented to Sir Dugald Clerk, Sir Herbert Jackson, Sir Daniel Hall and Sir Oliver Lodge, for their Trueman Wood lectures. Medals were also presented to Mr. A. F. Baillie, Dr. W. Cramp, Mr. W. Raitt and Sir Charles H. Bedford for papers of chemical interest.

AT the meeting of the Chemical, Metallurgical and Mining Society of South Africa, held on October 15, the following gold medals were presented under the terms of the society's research endowment fund. For chemical research to Dr. James Moir; for metallurgical research to Dr. William Arthur Caldecott and Henry A. White; for mining research to John Innes.

DR. R. W. WOODWARD has resigned as physicist and chief of the section of mechanical metallurgy of the Bureau of Standards, Washington, D. C., to become chief metallurgist for the Whitney Manufacturing Company, Hartford, Conn.

PROFESSOR HENRY H. JEFFCOTT has recently been appointed successor to Dr. J. H. T. Tudsbery as secretary of the Institute of Civil Engineers, London.

PROFESSOR H. DOLD, of the Institute for Experimental Therapy in Frankfurt-on-Main, has been appointed to the charge of the sero-diagnostic department of the Emil von Behring Institute, under the supervision of Professor Uhlenhuth.

DR. F. E. KNOCH, superintendent of the United Oil Company, Florence, Colorado, and

Dr. S. K. Loy, chief chemist for the Rocky Mountain Division of the Standard Oil Company (Inc.), Casper, Wyoming, have accepted appointments as consulting chemists to the U. S. Bureau of Mines. They will assist the regular staff in the investigations now being carried on by the bureau with Colorado and Utah oil shales at its Boulder and Salt Lake stations.

JAMES H. MASON KNOX, JR., associate in clinical pediatrics in the John Hopkins Medical School, has been granted a year's leave of absence to assume charge of child welfare work in Europe, under the Red Cross.

GAICHI YAMADA, assistant professor of metallurgy at the Kyoto Imperial University of Kyoto, Japan, has been visiting the mills and smelters of the Great Lakes district in conclusion to a year's tour of the United States.

DR. CAYETANO LOPEZ, port inspector of Barcelona for the Spanish Bureau of Animal Industry, recently spent some time in Washington studying the organization and methods of the Bureau of Animal Industry of the United States Department of Agriculture with special reference to bacteriology and pathology. The Spanish Government contemplates the establishment of a laboratory in connection with the agricultural department for the study of animal diseases.

PROFESSOR ARTHUR DE JACZEWSKI, director of the Institute of Mycology and Phytopathology at Petrograd and president of the Russian Mycological and Phytopathological Society, and Professor N. I. Vavilov, director of the Bureau of Applied Botany and Plant Breeding at Petrograd and editor-in-chief of the Russian Phytopathological Society, who came to the United States last August as the guests of the American Phytopathological Society, have completed their study trip through this country, and the following telegram has been received from them: "Leaving America we wish to send our American friends a last farewell and to thank you once more for the heartfelt and kind reception that made our trip in this country so pleasant and useful. We shall never forget the time spent with American scientists, and we hope that the connections established now in such a good way will be continued for the good of science and of our countries."

DR. W. H. PARKS, director of the research laboratory in the New York Board of Health, was the guest of the Wisconsin Branch of the Society of American Bacteriologists on December 2. In the afternoon he gave a lecture on "The Importance of the Schick Test in the Control of Diphtheria," which was open to the public. This was followed in the evening by a dinner and smoker at the University Club where Dr. Parks spoke informally about the work of his laboratory.

A COURSE of ten lectures in applied anthropology will be given under the auspices of the Young Men's Christian Association and the Institute of Vocational Research of Washington, D. C., by Dr. Aleš Hrdlička of the U. S. National Museum.

PROFESSOR J. H. WALTON, of the department of chemistry of the University of Wisconsin, lectured before the Milwaukee section of the American Chemical Society on November 18, on the subject "The Influence of Impurities on the Rate of Growth of Certain Crystals."

THE second of the series of lectures on the "Progress of Science," under the auspices of the Society of Sigma Xi, Columbia Chapter, was held on December 15, by Dr. James Kendall, associate professor of chemistry, on "Recent progress in the science of chemistry."

A BUST of the late Professor G. Galeotti is to be placed in the pathological institute at Naples.

SIR DOUGLAS FOX, past president of the Institute of Civil Engineers and honorary member of the American Society of Civil Engineers, died in London on November 12, at the age of eighty-one years.

MR. EDWARD WINDSOR RICHARDS, a past president of the Institution of Mechanical Engineers and of the Iron and Steel Institute, died on November 12, at the age of ninety years.

DR. PETER THOMPSON, professor of anatomy

at the University of Birmington and dean of the faculty of medicine, died recently at the age of fifty years.

Professor Erb, the neurologist, of Heidelberg, has died at the age of eighty-three years.

For the Toronto meeting of the American Association one of the attractions will be an exhibition of scientific apparatus and products held under the auspices of the association. It is hoped that firms and individual scientific men who have something new to exhibit will take advantage of this exhibition. The exhibition is in charge of an exhibition committee at Toronto, the chairman of this committee being Professor F. E. Burton, of the University of Toronto. Arrangements for entering exhibits are to be made by direct correspondence with Professor Burton.

The American Anthropological Association will meet in conjunction with the American Folk-lore Society, the Maya Society and the Southwest Society at the Brooklyn Institute Museum from December 28 to 30 inclusive.

The Geological Society of America will meet at Amherst, Mass., from December 28 to 30.

The date for the Birmingham, Ala., meeting of the American Chemical Society has been placed from April 4 to 7, 1922.

The American Petroleum Institute held its annual meeting at the Congress Hotel, Chicago, on December 6, 7 and 8.

The tenth International Congress of Otology will be held in Paris next year. Dr. A. Hautant of Paris is secretary-general of the French committee.

UNIVERSITY AND EDUCATIONAL NEWS

The Molteno Institute for Research in Parasitology, presented to the University of Cambridge by Mr. and Mrs. Percy A. Molteno, was formally opened on November 28.

Dr. Henry Laurens, formerly assistant professor in biology in Yale College, has been promoted to be an associate professor of physiology and transferred from the department of zoology to the medical school faculty, where he has charge of the physiology. Associated with him is Dr. W. F. Hamilton, formerly instructor in physiology in the University of Texas. Dr. J. W. Buchanan (University of Chicago) has been appointed an instructor in biology in Yale College in Dr. Laurens's place.

Dr. Lansing S. Wells, until recently research chemist with the Barrett Company, Philadelphia, has accepted an appointment as assistant professor of organic and physical chemistry at the Montana State College, Bozeman, Mont.

Dr. Glen E. Cullen has been elected associate professor of research medicine, and Dr. Goldschmidt, former lecturer in physiology in the School of Medicine, Cornell University, Ithaca, N. Y., has been elected assistant professor of physiology in the School of Medicine of the University of Pennsylvania. Dr. James Harold Austin was elected, last spring, professor of research medicine, to succeed Dr. Richard M. Pearce, who resigned to accept a position with the Rockefeller Foundation.

Mr. Herbert H. Tanner has been appointed assistant professor of chemistry in the University of Oregon.

Julian D. Carrington, lately curator of biology at Cornell University, has resigned to become assistant professor of biology at the University of South Carolina.

Appointments for the present year at the Case School of Applied Science include Dr. H. H. Lester, from the University of Washington and commercial work, to be assistant professor of physics, and Dr. J. J. Nassau, from Syracuse University, to be assistant professor of mathematics and astronomy.

DISCUSSION AND CORRESPONDENCE

IN ASSISTANCE OF THE ARCHIVES DE BIOLOGIE

It will be remembered by the biological laboratories of about one hundred and fifty colleges and universities that last spring their attention was called to sets of lantern slides made from photomicrographs of Nereis egg preparations put up by Professor O. Van der Stricht, of the University of Ghent. The

negatives were loaned the writer by Professor T. Wingate Todd, director of the anatomical laboratory of Western Reserve University, where Professor Van der Stricht was a guest for some time during the war.

It was understood that profits from the sale of the slides should go for the benefit of the *Archives de Biologie.* of which Professors Van der Stricht and Brachet are editors. Concerning the Archives Professor Van der Stricht had written in July, 1919:

> . . . we need your valuable support, for we will lose half of our subscribers, the Germans and Austrians. . . . The Belgian government has not yet a penny available for laboratory work. In spite of all, we are very confident . . . and Belgium, with the support of the States, will live again.

The use of the cytological preparations for purposes of securing funds was, of course, not thought of by their maker, but seemed quite legitimate to us. This communication in SCIENCE is thus intended as an informal report to the considerable number of institutions who cooperated by their orders as to the outcome of the scheme.

Up to the present time two remittances have been sent, totalling $350. At the prevailing rate of exchange this allowed a realization of 4703 francs.

In the letters accompanying the remittances the liberty was taken of using the following wording, in part:

> You must accept this small sum as being the result of your own labor. Incidentally you may well feel that you have assisted instruction as given in numerous American institutions; for not only in courses dealing with embryology and heredity, but also in all introductory courses in general biology the phenomena of maturation, fertilization and cell division constitute fundamental information . . . much credit is due the institutions which purchased the lantern slides, for without their orders our little enterprise would have been a failure.

In acknowledgment Professor Van der Stricht said, in part:

> In agreement with my colleague, Dr. Brachet, we gratefully accept this amount which will be devoted to the publication of the *Archives de Biologie.* The cost of issuing this journal is, indeed, very great just now. Subscriptions do not cover it, so that we lose a great deal of money. Fortunately, my appeal in 1919 to the United States colleagues (for subscriptions) has been rather gratifyingly answered; many orders for sets came in, so that we were able to continue printing. Your . . . donations will help us very much for this purpose. Thus we owe our "Zoological Friends in America" an immeasurable debt of gratitude.

I would like to add that sets of these lantern slides may still be obtained, though we are not making them except on receipt of orders. They clearly illustrate twelve important steps in maturation, fertilization, and the first cleavage of the eggs of *Nereis limbata.* The price is $15 for the twelve slides, and the mutual agreement is that all receipts above actual expenses shall go for the assistance of Belgian science in the manner above indicated.

ROBERT A. BUDINGTON

SPEAR LABORATORY, OBERLIN COLLEGE,
OBERLIN, OHIO

THE VIBRATIONS OF A TUNING FORK

TO THE EDITOR OF SCIENCE: In a number of SCIENCE,[1] which has just come to our attention, Professor Charles K. Wead makes the following statement:

> In a recent article in a psychological journal the tuning fork is considered as composed of two bars each attached at one end to a solid block.

He then proceeds to describe Chladni's theory of the tuning fork to correct this "surprising" disclosure.

After reading Professor Wead's note we referred to our original paper.[2] In comparing vibrating bars and forks we write:

> The bar is, in fact, a fork straightened out; or, which is the same thing, the fork is a bar bent into the shape of a U. If we gradually bend a bar into a U, the two nodes approach the base. When the bending is complete we have a single node at the base—*i.e.,* a fork.

Our point, of course, is that the tuning fork *is* essentially a bar—a single vibrating system.

[1] Nov. 11, 1921, 468–9.

[2] *Psychological Bulletin,* September, 1918, 293 f.

Nowhere do we regard the fork as made up of two bars attached to a solid base. Since the question of how we may best regard a vibrating tuning fork has been raised, we have turned once more to Rayleigh.[3] After a mathematical discussion he writes:

> . . . These laws find an important application in the case of tuning forks, whose prongs vibrate as rods, fixed at the ends where they join the stalk, and free at the other ends.

Also Edwin H. Barton,[4] a pupil of Lord Rayleigh, writes:

> The behavior of the U-shaped bars just dealt with approximates to that of tuning forks. But the vibration of tuning forks is usually further complicated by the presence of an additional block at the center of the bend and the stem attached thereto. Indeed, it may be a nearer approximation to regard each prong as a straight bar fixed at the end near the stem and free at the other end.

It appears, then, that this "crude" manner of considering a tuning fork, which has been wrongly attributed to us, is actually accepted by no less an authority than Rayleigh and his pupil, Barton.

Professor Wead's interpretation of our view is probably based upon our statement that the fork has a single node at the base. This, of course, is only an approximation.

An alternative explanation, according to Professor F. R. Watson, of this university, is to consider the fork as a single vibrating system in which the center of mass tends to remain fixed in position. As the tines of the fork are bending outward, the center of mass tends to lower, so that the stem and block of the fork rise a bit so as to keep the position of the center of mass unchanged. As the tines return inward, the center of mass tends to rise, so that the stem of the fork lowers. The stem of the fork thus executes minute up and down movements.

Paul Thomas Young
University of Illinois

3 "Theory of Sound," 1894, Vol. I., 274.

4 "A Text-Book on Sound," 1908, 298.

AN ANECDOTE CONCERNING DR. FIELD

I have read with great interest Dr. Ward's sketch of the life and work of the late Herbert Haviland Field. It, however, omits any mention of his appreciation of humor, and perhaps I may be allowed to tell of one of his practical jokes which, to me at least, was most amusing.

The late Henry B. Pollard had just completed his work on the anatomy of *Polypterus* and had gone from Wiedersheim's laboratory for lunch. I came in a little later, started my studies, and then Pollard came in, and in a moment I realized what "Uncle Toby" meant when he referred to the profanity of "our army in Flanders." Pollard turned to me, holding up a drawing of the cranial nerves of that fish which was almost completely covered with hæmatoxylin, and demanded who did it. I knew nothing of it and so replied. Pollard said he would call the attention of the professor (Wiedersheim) to it and at once left the room. As he went out of one door of the laboratory, the door from the anatomical museum opened and in came Field, who removed the damaged drawing from Pollard's table, opened a drawer and took out another drawing, and again left the room. Pollard almost immediately returned, bringing the professor with him. "Look at that!" said Pollard. "Was ist los?" asked Wiedersheim, and then Pollard looked and saw his drawing in perfect condition. I never saw such an expression of complete inability to comprehend as that on Pollard's face. He was utterly without words, The explanation of the whole was that Field had found the tracing paper which Pollard had used, had rapidly redrawn on another sheet the nerves and skull of *Polypterus,* had deluged it with staining fluid and left it for Pollard to find, waiting in the museum to hear what the English youth would and could say.

S.

TWO RETROSPECTIVE FEATURES OF THE TORONTO MEETING

The membership list in the last volume of the Summarized Proceedings, recently published, shows that the Association has a considerable number of members living in coun-

tries outside of the United States. Naturally, from the contiguity of Canada, the largest number of those foreign members reside there, the list showing 230 names of residents of Canada. This number is larger than the total membership of the Royal Society of Canada, which, however, limits its membership. But it is small in comparison with the total membership of the Association, although not insignificant in view of the fact that no meetings have been held in Canada since the last Toronto meeting thirty-two years ago. After the meeting of 1889, the next following list contained 85 names of members and fellows resident in Canada. While only seven of these 85 persons now survive as members, the present Canadian membership of 230 indicates that accessions have been increasing, and doubtless there will be further increases as a result of the meeting about to be held.

The place of the meeting is also a reminder that the Geological Society, at the time of the last meeting in Toronto, took a step toward organization as an independent body, which was the beginning of a movement that has eventually contributed to the remarkable growth of the Association. The recently issued volume shows that in addition to the large membership of nearly 12,000, there are now 93 affiliated and associated societies, most of which have been organized since 1889.

A. F. Hunter

Normal School Building,
Toronto, Nov. 15, 1921

SCIENTIFIC BOOKS

The Life of the Pleistocene or Glacial Period. By Frank Collins Baker. University of Illinois Bulletin, vol. XVII., No. 41; June 7, 1920, iii, 476 pp. 8, pl. 1–57. Urbana, Illinois.

This portly volume is divided into two parts, the first including beside a historical summary of preceding researches an account of the postglacial geology and life of the Chicago area, followed by a résumé of our present knowledge of the postglacial life of the entire glaciated region of the United States and Canada. Each locality investigated is taken up separately, its stratigraphy and fossil content described and listed, and at the end of each chapter the collected data are summarized.

In the second part the life of the interglacial intervals is discussed and the species of plants and animals listed from data furnished by an indefatigable search of all available literature.

The difficulties attending the reduction to a common nomenclature of the records extending over many years, can easily be understood and the author frankly acknowledges that in some cases his judgment may have been at fault, but such instances do not materially affect the general conclusions and are inevitable in any such bringing together of scattered data of varying degrees of authenticity. The volume concludes with a bibliography of forty-five pages, covering the literature from 1846 to the date of publication and an ample index. Among the plates are interesting maps showing the fluctuations of the geographical features of the Chicago area and the region about Toronto, as well as the extensions at numerous periods of the continental ice sheet. It would have added to the convenience of those who use the volume if legends had been added to the plates, obviating the necessity of turning back in each instance to the printed explanation.

Much of the work, and presumably of the most carefully observed and valuable part of it, is the result of field work prosecuted by the author. The labor involved in the search for and correlation of the data in the literature was evidently prodigious, and reflects credit on the industry and patience of the author. His work in bringing together in orderly shape the data bearing on his subject will be a boon to all later students of the American Pleistocene. We may be permitted to regret the instrusion in a scientific work of a few of the "simplified spelling" futilities; we really *ot* not to imply that *thot* renders either the sound or the meaning of the word *thought*.

Wm. H. Dall

SPECIAL ARTICLES

THE EGG-LAYING HABITS OF MEGARHYSSA (THALESSA)

DURING the summer of 1921 I had frequent occasion to watch the females of the beautiful large Ichneumonid *Megarhyssa* (formerly *Thalessa*) in the act of ovipositing into the trunk of a decaying maple tree at Mendham, N. J. In looking over the literature on the subject, I find that this process, though often described and commented upon, does not seem to have been fully elucidated so far. There are at least two facts that have escaped attention of observers, namely first, that the ovipositor is always brought into a position at right angle to the bark *directly behind the thorax of the insect* and is held here in position by the hind coxae, allowing only upward and downward movements but no lateral excursions. It is only under this condition that one may correctly say that the insect "makes a derrick out of her body" (Comstock). The second point is, that the remarkable extensile membranous sac or disc into which the ovipositor enters with its basal part to allow of its being temporarily shortened, is not only formed twice, at the beginning and at the end of the process, but at the beginning *receives also the sheaths into its interior,* which are freed when the membrane collapses, as two separate loops, while at the end of the process, when the membranous sac forms again, the loops of the sheaths do not re-enter it, making it possible that one can tell whether the insect is just beginning or just ending operations.

It appears that the extensile membranous sac has been seen first and correctly interpreted by J. Quay,[1] who, however, does not mention the loops formed by the sheaths. The most complete and accurate account is given by C. V. Riley,[2] who describes the loops formed by the sheaths, which, as he correctly stated, do not enter the wood. But Riley is in error in his statement that the sheaths "have not followed the ovipositor within the membrane"; in fact they do so at the beginning of the process. According to Riley the sheaths make "a larger and larger loop *on one side of the body*[3] or even a valve on each side," and he figures the ovipositing insect with ovipositor and sheaths on one side of the body which is quite impossible. In the same figure, otherwise excellent, the ovipositor is drawn at a certain distance behind the end of the thorax, while, as I have stated above, it is held by the hind coxæ. Riley criticizes the previous illustrations (Blanchard, Wood), which figure *Thalessa* (*Rhyssa*) as ovipositing into insect larvæ which she never does.

More recently, Comstock[4] gives an illustration possibly adapted from Riley as it figures almost exactly the same stage in the egg-laying process, and especially as it continues both Riley's errors in figuring the ovipositor at a certain distance behind the thorax, and on one side of the body. The wings are drawn as if held vertically; the antennæ held farther upward than in Riley's picture. The vertical position of the wings is preserved in Kellogg's and Lutz's figures. Kellogg's figure[5] is almost identical with that (presumably older one) of Comstock but apparently redrawn as to details; the error of drawing the sheaths both on one side of the body has here been eliminated. The figure in The New International Encyclopaedia (2d edit., 1915, article "Ichneumon fly"), is adapted from Riley; the antennæ, however, are here drawn as if directed vertically upward—perhaps to save space. It should be noted that the egg-laying insect holds the antennaæ forward and often downward, touching the bark. This figure also shows both Riley's errors which I have commented upon. A new illustration is given in Lutz's "Field Book of Insects" (1918; Pl. LXXXVIII., p. 413); this illustration was, as Dr. Lutz tells me, not drawn from nature but combined from illustrations and a specimen they had. This picture is the first one in a long time to show a different stage in the process than that

[1] *American Entomologist,* Sept., 1880, Vol. III., p. 219.

[2] "Insect Life," Vol. I., 1889, p. 168 ff.

[3] Italics mine.

[4] "Manual for the Study of Insects," 13th edit., 1915, p. 623, Fig. 749.

[5] "Insects," 1905, Fig. 682.

figured by Riley, and the membranous disk is shown correctly with the sheaths inside, corresponding to the beginning of the boring process. But the position of the abdomen is impossible; indeed at this stage, when the disk is formed, the abdomen is held not only vertically but even bent forward to some extent above the thorax; and at no time during the whole process is the ovipositor inserted as far behind the insect as drawn by Lutz. Like Comstock, Lutz shows the wings in a vertical position and the antennæ are held obliquely upward which is possible but not characteristic. Mention should be made that Riley too, already gave a picture, undoubtedly from a preserved specimen, of the extended membrane, the two sheaths just leaving it, as would be the case as soon as the membrane begins to collapse. This illustration shows very well how the ovipositor at the beginning of the process is held in a vertical direction by being sunk into a ventral furrow of the abdomen, which renders its basal portion quite invisible.

It becomes a matter of interest that, of many authors commenting on such a familiar insect as our large, long-tailed ichneumon fly, and on its oviposition, only comparatively few have watched the process long enough to verify its details, and that, in fact, some of these details have never been clearly established though *Megarhyssa* is common in many localities. Does not this indicate that we have been neglecting the ecological for the systematic aspect of entomology?

Werner Marchand

Mendham, N. J.

A CONDENSATION PUMP

Condensation pumps of the following particular type have been used in our work for a number of years and the design seems to possess sufficient advantages over others in both simplicity and compactness to merit this note.

The method of operation of this pump, in which the exhausting process is accomplished in two stages, will be made clear by reference to the cut. In the initial or "rough" stage, *A*, the mercury vapor is ejected at relatively high pressure from a small nozzle into a long narrow throat. The nozzle opening is made sufficiently small that the pressure of the vapor

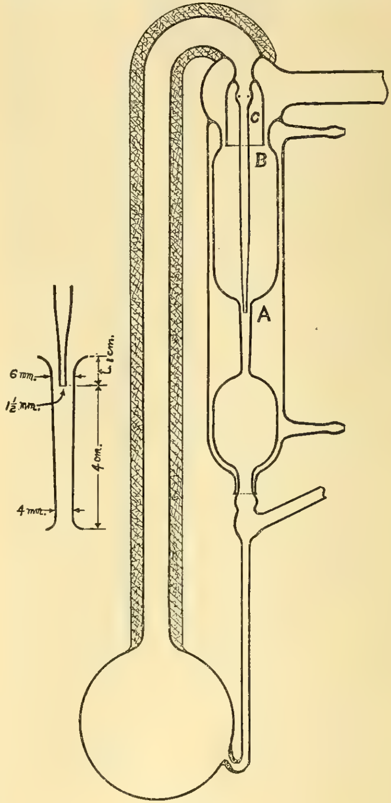

Fig. 1

in the boiler, instead of being practically limited to 2 or 3 millimeters, as in the case of the ordinary vapor pump, may attain a value of 75 millimeters or more depending upon the heating. The efficacy of this arrangement was first pointed out by Stimpson.[1] The evac-

[1] *Washington Acad. Sci. J.*, 7, pp. 477–482, Sept. 19, 1917.

uation is completed through the fine stage, *B*. In this unit a portion of the high-pressure vapor from the central tube is allowed to expand to a low pressure through one or two small openings into the inverted cup, *C*. This vapor then escapes freely into the large water jacketed tube and gives the conditions essential for high-speed exhaustion.

It has found that the high-pressure stage operating alone, without assistance from the low-pressure unit, will produce a high vacuum. The speed of the high-pressure unit by itself, however, is very much less than that of the combination, which possesses a speed comparable with that of a single stage pump of equivalent proportions.

The advantage of the combined units, of course, lies in the fact that such a pump will function in a perfectly satisfactory fashion with a very ordinary fore-vacuum. A mechanical pump capable of reducing the pressure to 2 or 3 millimeters is satisfactory, or even a water aspirator which will give a vacuum of 20 millimeters can be used if nothing better is available.

With regard to the construction of the pump perhaps a little may be said. Glass possessing a low coefficient of expansion such as Pyrex or Corning G702P glass must be used in making it, as otherwise one will almost certainly experience the rather annoying inconvenience of having the boiler crack upon application of the heat. The size of the pump can, of course, be varied considerably, but the general proportions of the parts given in the drawing are found to be very satisfactory. In the pump from which the drawing was made the mecury boiler has a diameter of 90 millimeters and the other dimensions were reduced proportionately. The dimensions of the jet and throat which have been found to work well are indicated in the enlarged sketch of this part. The diameters given apply to the tube openings. The thickness of the nozzle wall should be as thin as is consistent with reasonable strength. The two small openings which serve to furnish a supply of vapor to the upper unit are about the size of ordinary pin holes and are located on opposite sides of a small enlargement in the central tube. The joint between the lower end of the water jacket and the body of the pump is made water tight by binding it tightly with strips of thin rubber. There is some advantage in having a slight constriction where the mercury return tube is sealed to the boiler as the presence of a constriction here tends to preserve the equilibrium of the mercury in the return tube.

The mercury in the boiler should be about 2 centimeters in depth at the center and ordinarily, with a properly adjusted flame, it will evaporate without serious bumping even at the higher pressures. The height of the mercury column in the return tube indicates the vapor pressure in the boiler and the pressure required for satisfactory pumping depends entirely upon the fore-vacuum. There is no harm, however, in running the vapor pressure up as high as the length of the return tube will permit if this be necessary to enable the pump to function.

E. H. KURTH

PALMER PHYSICAL LABORATORY,
PRINCETON, N. J.

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

C. E. Coates, Chairman
T. J. Bryan, Secretary

The testing and grading of food gelatins: CLARKE E. DAVIS AND EARL T. OAKES. Loeb's recent work on gelatin is briefly discussed and Bancroft's objections to Loeb's conclusions on the basis of the insolubility of gelatin as based on surface tension measurements by Slobeki are shown to be in error. Methods for determining gel strength and viscosity are given and the effects of various factors affecting these properties are discussed with data. Data on the causes for discrepancies between grading gelatins by gel strength tests and by viscosity measurements are given. Gelatins submitted by the manufacturers as examples in which gel strength does not parallel viscosity are shown to be classified alike by gel strength and viscosity measurements under the methods described.

Active chlorine as a germicide for milk and

milk products: Harrison Hale and William L. Bleecker. The increasing and satisfactory use of active chlorine as a germicide for water suggests the possibility of its use for milk and milk products. Numerous bacteriological tests show a reduction in number of bacteria in general proportional to the amount of active chlorine present. Chlorine water, sodium hypochlorite and calcium hypochlorite solutions were used on milk and ice cream in dilutions varying from 1 part of active chlorine to 1000 parts of milk to 1 part to 100,000. Chlorine water in 45 minutes produces practically the same results that sodium hypochlorite does in 1½ hours and calcium hypochlorite in 19 hours.

The inadequacy of analytical data: H. E. Barnard.

The chemistry of leavening agents: Clark E. Davis and D. J. Maveety.

Availability of salts in soils as indicated by soil colloids: N. E. Gordon. Iron, alumina and silica gels were prepared in the purest possible condition and shaken with various salt solutions until equilibrium was established. The maximum adsorption was determined. Then by a series of washings it was found in what way and to what extent the adsorbed salt became available for plant food. Furthermore, a series of experiments showed that the hydrogen-ion concentration plays a very important rôle in the availability of salts which are held by soil colloids.

The effect of pectin, acid and sugar on the character of gels: C. A. Peters and R. K. Stratford. Pectin extracted from apple pumace by water was used and a standardized method for making gels in 10 c.c. portions was developed. Acidity of 0.3 per cent. was necessary for gelation and acid above 0.3 per cent. did not increase the stiffness of gels. As the per cent. of pectin was increased the amount of sugar had to be increased to make the stiffest gel; with a certain per cent. of pectin less sugar makes a softer gel, an increase of sugar makes a stiffer gel while a further increase of sugar makes a gel less stiff. The character of the gel depends upon the hydrolysis of both the sugar and pectin.

Nutritive studies of the Georgia velvet bean, Stizolobium Deeringianum. III. *Supplementary relationship of whole and skimmed milk to the hulled seed and the whole plant:* J. W. Read and Barnett Sure. An earlier paper[1] in this series of studies on the nutritive value of the Georgia velvet bean showed that the raw bean is injurious to rats. If the ration is supplemented with a liberal supply of whole milk, rats grew at a rate even more rapid than normal, and three generations were successfully reared on this diet. Inasmuch as previous work had shown the velvet bean to be quite rich in the fat-soluble vitamine, experiments employing skimmed milk instead of whole milk and replacing the dextrin by starch were tried, but rearing of the young in two cases was not successful. In the case of the whole plant, however, a healthy and vigorous third generation was secured on such a simple and poorly constituted diet as that composed of 40 per cent. velvet bean hay (ground whole plant), 60 per cent. starch, and a liberal supply of skimmed milk.

Nutritive value of the Georgia velvet bean (Stizilobium Deeringianum). (a) Supplementary relationship of leaf and the hulls of seed. (b) Nutritive value of the whole plant: Barnett Sure and J. W. Read. Our previous work[2] on the nutritive value of the Georgia velvet bean showed the seed to be abundant in the fat-soluble vitamine, but deficient in protein, salts, and the water-soluble vitamine. In this study we have found the leaf to be abundant in the water soluble and an efficient carrier of salts. The hulls, however, possessed no supplementary value to the seed, and they interfered with the utilization of the fat-soluble vitamine in the seed, as did also the velvet bean hay. Autoclaving the hulls for two hours at 15 pounds pressure did not change their disturbing effect. The data secured suggest that the interference with the utilization of the fat-soluble vitamine may possibly be due to indigestible celluloses.

Calcium chloride as a mineral supplement in the ration. (Preliminary report): J. W. Read and Barnett Sure. The literature contains the results of experiments conducted by several investigators within the last eight or ten years on the benefits derived from the addition of small quantities of calcium chloride to the ration. We considered it of possible value to check up on some of the results which have been reported, and have in progress certain experiments with rats, in which cotton seed meal constitutes 35 and 50 per cent. of the two basal rations which receive calcium chloride additions varying from 0.60 to 16.00 grams of the tetrahydrate salt per kilogram of ration. The rations receiving calcium chloride are compared to the controls free from salt additions, and to rations receiv-

[1] "Biological Analysis of the Seed of the Georgia Velvet Bean, *Stizolobium Deeringianum*," *Jour. Agr. Res.*, Vol. XXII., No. 1, pp. 5–18.

[2] *Jour. Agr. Res.*, XXI., No. 9.

ing sodium chloride and calcium carbonate. Our results to date show rather remarkable responses to small amounts of calcium chloride, even as low as 0.6 of a gram to a kilogram of ration proves to be as effective as any of the higher additions of this salt. At this time, however, our experiments have not been in progress long enough to permit any definite conclusions, but they are being continued and will be reported later.

Sugar beets in Louisiana: C. E. COATES AND A. F. KIDDER. A long series of results show that it is possible to grow sugar beets of high sucrose and high purity in Louisiana and to obtain heavy yields. This is probably true for the South in general. The best results are obtained by late spring planting. The yields average 18 tons per acre; the purities about 85.0 and the sucrose 14.0. The essential feature is the necessity for obtaining good beet seed which breed true to type. Seed grown in the United States today fulfill these requirements.

Causes of hominy black. EDWARD F. KOHMAN.

The volatile acids and the volatile oxidizable substances of cream and experimental butter: L. W. FERRIS. In collaboration with Dr. H. W. REDFIELD AND W. R. NORTH. There has been found a noticeable difference between the amount of volatile acids found by distillation without saponification in butter made from sweet cream and the amount found in butter made from sour cream, the acidity of which had been reduced before pasteurization. The amount of volatile oxidizable substances was high and the lactose very low on the samples of butter made from cream which contained the higher numbers of lactose-splitting yeasts.

Some determinations on the soluble nitrogen compounds of cream and butter: L. W. FERRIS. The paper gives some of the results obtained in connection with an investigation of cream and butter conducted by Dr. H. W. Redfield and continued by the author. The report shows the relation of amino nitrogen and ammonia to total nitrogen and the relation of the nitrogen not precipitated by phosphotungstic acid to total nitrogen in cream and in butter when fresh and after being held under different conditions of storage. The greatest per cent. of such nitrogen, when the butter was fresh, and also the greatest increase during storage, was found in butter made from cream which had been allowed to sour before being pasteurized.

A method for the determination of amino nitrogen and ammonia in cream and butter: L. W. FERRIS. Picric acid and acetic acid are used to separate the protein and higher complex substances from the lower degradation products. The amount of nitrogen in the filtrate reacting with nitrous acid in Van Slyke's amino acid apparatus is determined. The filtrate can be held for some time without change in the amount of reacting nitrogen, and hydrolysis of the proteins during analysis is reduced to a minimum. It is found that there is a correlation between the ratio of the amino and ammonia nitrogen to the total nitrogen, and the quality of the sample.

The viscosity of natural and "remade milk." Food control laboratory: OSCAR L. EVENSON AND LESLIE W. FERRIS. The relation of viscosity to total solids is shown by means of the expression:

$\frac{v - 1}{\text{T. S.}}$, in which

$$v = \frac{\text{Time of flow of milk} \times \text{sp. gr. of milk}}{\text{Time of flow of water} \times \text{sp. gr. of water}}.$$

T. S. equals total solids. For a given number of samples, the values for $(v - 1)/\text{T. S.}$ for natural milk varies from 5.68 to 7.18 and for remade milk from 6.37 to 12.60 at 25° C. The viscosity of milk as determined is, to a certain extent, dependent upon the temperature at which the milk has been held. Homogenizing at a high pressure increases the viscosity while emulsifying has little or no effect.

Composition basis for considering the water requirements of plants: H. A. NOYES. Higher moisture contents in orchard soils were found to occur on those plots where increased bacterial activities resulting from aeration of the soil had increased plant growth and markedly changed the analyses of the plants. As the result of the field work, given above, controlled greenhouse investigations were undertaken with different fertilizer treatments to study variations in analysis as related to changes in the water requirement of plants. In one set of experiments the water requirement (per unit of dry matter) decreased from 1,785 to 1,215 with a variation of 15 per cent. in the nitrogen content and 23 per cent. in the ash content of plants grown under different fertilizer treatments. A second set of experiments on a different soil and with a different crop showed a variation in water requirement of from 37.9 to 16.1 (per unit green weight) with a variation of 74 per cent. nitrogen content, 176 per cent. in phosphorus content of ash and 66 per cent. in the ash content of plants grown under different fertilizer treatments. The hypothesis adopted on the basis of these results is *that when a soil that will respond to fertilizer treatment (direct or indirect) is fertilized the plants growing in that*

soil are able to make their growth (approach normal) on less moisture and analyze differently than they otherwise would.

DIVISION OF DYE CHEMISTRY

A. B. Davis, Chairman
R. Norris Shreve, Secretary

The dye situation in Canada: W. F. Prescott.

Contribution to the chemistry of cyan-xanthen and cyan-acridinium: George Heyl. In the course of researches undertaken with a view of introducing into the acridinium molecule other groups to render the dye more toxic toward certain pathogenic organisms, it was found that a number of new dyes can be produced, heretofore not recorded. The development of these new dyes is accompanied by structural formulae and notes on the laboratory technique used. The biological value of the cyan dyes is not discussed, as the biological experiments are as yet incomplete.

Lakes from phenetidin: Dr. J. C. Schmidt. Phenetidin and derivatives when diazotized and coupled with beta naphthol or R salt form colors that range in shade from an orange to scarlet and to deep maroon. Some of these pigments are soluble, others insoluble in oils. These colors are remarkable for fastness to light and brilliancy, rivalling those produced from alizarine. Their qualities make them valuable for the manufacture of lakes for printing ink, and painting purposes, varnish stains, coloring waxes and paraffin also for printing textiles.

The synthesis of anthraquinone from phthalic anhydride and benzene: E. R. Harding. The Friedel Crafts reaction for the preparation of ortho benzoyl benzoic acid was studied extensively. Phthalic anhydride reacts with benzene and aluminum chloride to give an unstable intermediate compound which is easily decomposed to give a salt of benzoyl benzoic acid. This acid is readily converted to anthraquinone by heating with sulfuric acid. The yields throughout are good. The process is commercially attractive because the raw materials are abundant and comparatively low priced. Anthraquinone produced from anthracene so far has been expensive on account of the cost of anthracene, the removal of which from tar leaves a pitch of low value.

A direct reading spectrophotometer for measuring the transmissivity of liquids: Irwin G. Priest. This instrument has been designed to provide means for *rapid* and convenient as well as accurate work, particularly in the technologic examination of dye solutions and oils. It consists essentially of a combination of a constant deviation wave-length spectrometer and the author's "exponential" or "variation of thickness" photometer. Wave-length and transmissive index ("extinction coefficient") are both read *directly* from the instrument scales without any computation. A model instrument constructed in the Bureau of Standards Instrument Shop was exhibited at the Chemical Exposition Sept. 12–17, 1921. The instrument will be fully described in a forthcoming Bureau of Standards publication to which reference should be made for details. Interested persons may have their names placed on the mailing list for this paper by addressing the Bureau of Standards, Div. IV, Sec. 3, Washington, D. C.

Naphthalene sulphonic acids. IV. *The solubilities of some amino salts of naphthalene sulphonic acids:* H. Wales. Solubilities of the salts of alpha and beta naphthylamine with some naphthalene sulphonic acids have been determined between 25° and 98° C. Allotropic changes are indicated for two of the salts and an interesting relation between the solubility and structure of a series of isomers is shown.

The preparation of alpha gamma quinolines. I. *2, 4 dimethyl, 6 ethoxy quinoline: An improved method for its preparation and a study of the condensation:* S. Palkin and M. Harris. A study has been made of the conditions affecting the yield and quality of 2, 4 dimethyl, 6 ethoxy quinoline as prepared by the Beyer (Pfitzinger) synthesis for alpha gamma quinolines. Tolerance toward water and temperature variation and effect of oxidation in the synthesis; also relative effectiveness of purification reactions introduced by Mikeska for the recovery of pure base have been investigated. Boiling range curves (at 30 mm.) for the base at different stages of purification have been worked out. One of the principal difficulties incident to the recovery of the base from the reaction mixture, has been overcome by the application of a steam treatment rendering possible the elimination of tedious extractions or steam distillations. An improved process (depending on the Beyer-Pfitzinger synthesis) for 2, 4 dimethyl, 6 ethoxy quinoline, is described, which is much simpler of manipulation, requires less time to carry out, is adaptable to larger scale operation, and yields 10 to 15 per cent. more pure base than by the former method.

Charles L. Parsons,
Secretary

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THE OUTLOOK FOR AGRICULTURAL RESEARCH

AT the close of the World War, the outlook for research in the United States, both as to its immediate future and as to its permanent place in our economic structure, was very rosy. The tremendous part which the results of new discoveries played in the conduct of the war and in the sustenance of the nations whose normal productive energies were being diverted to war purposes, had attracted popular attention to and support of research activities. Research men had received new impetus and enthusiasm from the practical benefits of their work which became suddenly manifest. Organization of research agencies and the general recognition of the possibilities of cooperative organized attack upon the problems which need scientific study seemed to promise much for the immediate future of research work.

All this seemed to be particularly true of research in agriculture. The vital importance of the products of agriculture to the national need had been emphasized again by the war-time needs and slogans. Nations, like ours, which had been going through a period of almost inconceivable industrial development had come to hold in light esteem the earlier understanding of the importance of a sound and permanent agricultural system, which knowledge had been forced upon the preceding generation of American statesmen by the post-Civil-War experiences. But the vital importance of a steady production of a sufficient supply of agricultural products for the world's needs had been so emphasized by the war, and America's strategic position as a food-producing nation had been so clearly shown, that it seemed that a re-awakening of public interest in the support of anything which would aid in insuring a sound national agricultural policy was inevitable.

Now, however, the expected *renaissance* in agricultural research seems to have been temporarily thwarted by the business depression and by the general clamor against increased expenditures of public funds for any purpose. I believe that this condition is only a temporary one. We are going through an experience which brings a blush of shame to the cheek of every loyal American. We are seeing every principle of patriotism and devotion to public welfare which were such powerful stimulants to individual and national effort during the war submerged by the petty political jealousies.

These are reconstruction days. War-time fever has only just left the body politic. Physical power, mental acumen, and spiritual force seem to be still at a low ebb. No true American patriot believes that these are manifestations of sound, normal American life. And every true American, embued with the characteristic hopeful American spirit, looks forward with optimistic confidence to a speedy recovery of sound body and sound mind in our national existence.

Hence, we ought not to be discouraged or dismayed by the present temporary reaction in popular enthusiasm for our research work. This lack of enthusiasm ought not to be mistaken by us to be any definite or permanent opposition to agricultural research. The lessons of the war-time emergency concerning the importance of agriculture to the national life are too clear and too convincing to be easily forgotten. Indeed, it is the plain duty of those of us who, by our engagement in public service for agricultural development, have a unique opportunity to shape public opinion and to mold public sentiment, to see to it that this important lesson is not forgotten and that the proper place of agricultural research in relation to sound agricultural development continues to be kept clearly in mind.

The fundamental place of agricultural research in any system of agricultural education and development is so apparent that it needs no elaborate discussion or argument concerning it. It is an old and trite saying that "no stream can rise higher than its source." And it is a self-evident fact that the source of agricultural knowledge is careful scientific investigation of the laws of nature.

This was clearly recognized by the earlier leaders in agriculture who, soon after the establishment of the Land-Grant Colleges began the investigational work which soon led the way to the establishment of the agricultural experiment stations as definitely organized agencies for agricultural research work. In most of the States these stations were organized as a unit of the college and under the administrative supervision of the same officers who administered the teaching functions of the institutions. In a few states there were organized experiment stations which were entirely separated in their administration, functions, and activities from the teaching service. But in most cases the research work was closely associated with the teaching duties of the faculty of the agricultural college, and in about one-half of the states the college itself is an integral part of the state university with its graduate school, which also has general research possibilities.

The need for post-graduate training for teaching, research, and extension workers in agriculture has resulted in the development of graduate schools in many of the separately organized land-grant colleges. Thus it has come about that in most of the states there are two agencies or units of the land-grant colleges, which are to be considered as potential sources for agricultural research work; namely, the experiment station and the graduate school.

In any consideration of the future possibilities for agricultural research, therefore, we ought to count upon the development of these two types of agencies. The growth of these two, side by side, in the same institutions has often led to a confusion of their functions and possibilities, which may be wholly unconscious and unintentional in the minds of the members of the staff and administrative officers of these combined institutions; but which is quite apparent to those

of us who are connected with the separate research institutions. It is, perhaps, because of my recent change from one type of these institutions to the other that the inevitable distinctions between graduate school research work in agriculture and agricultural experiment station research work have forced themselves upon me. They now appear to me to be so significant as to justify my commenting upon them in the hope of at least partially clarifying the situation and so affording a better basis for future development of all of the possibilities of agricultural research work.

The questions at issue may be more clearly indicated if formulated into two definite queries, the reply to the first of which is necessarily dependent upon the answer to the second. These questions are: "Is the maintenance of an experiment station as a separate unit of the land-grant college desirable?" and "How does an experiment station differ in its methods and accomplishments from other agencies for research, such as the graduate school, or the personal research work of an academic faculty?"

Turning first to the second of these questions, namely, "How does an experiment station differ from other agencies for research?" my answer is that it differs in the environment or atmosphere which it creates. Its atmosphere is that of research for the accomplishment of definite economic progress; while that of the graduate school is chiefly research for training of graduate students in the method of critical investigation, and that of individual research work is the promotion of individual professional standing and welfare. Now, I recognize many exceptions which might be taken to such a generalization when applied to the cases of brilliant individual research workers in these different organizations. But I am discussing now the environmental conditions of the organized entities or institutions known respectively as experiment stations, graduate schools, or university faculties.

As between the research work done at an experiment station and that done at a graduate school, both parts of the same land-grant college for example, the physical materials worked with may be the same and the final results of the investigation of any given problem by either agency ought to be the same, provided the ultimate truth of the matter is reached; but the environment under which the investigators will work is essentially different. In both organizations there may be less mature and less experienced investigators working under the inspiration and guidance of older and more experienced research men; but in the graduate school the immediate object to be attained is the completion of the work in such a way that it can be formulated into and defended before a group of examiners as a thesis; while in the station, the investigation is to eventuate in some contribution to agricultural science or practise which must stand the test of practical application in farm management operations. It is possible that the methods and mental attitude of the leader of the work toward its ultimate outcome may be identical in each case; but that of his assistants will most certainly be different, and the leader himself is almost super-human if he is not influenced by the desire to see his students present "a good thesis" as the result of the work. But the more essential differences lie in the undivided interest in and devotion to research problems which is, or at least ought to be, characteristic of the experiment station. Faculty men necessarily have to be interested in class-room problems and in the preparation of the results of their research in forms which are pedagogically sound and academically attractive. Graduate students are usually taking course work in addition to thesis work and are likely to have their interest in their investigations diverted from the main issue, or their observations influenced by their coordination or contrast with class-room ideas. I am not arguing against research work in the graduate schools. On the contrary, I regard it as the very essence, the *sine qua non*, of graduate school work. Neither would I belittle the economic value of the

results of the research work which is so well done in the graduate school.

What I am trying to point out is that there is a definite atmosphere or environment favorable to agricultural research which is provided by the experiment station organization which can not be provided by any other research agency. This being my answer to the second question propounded above, the answer to the first, namely, "Is the maintenance of a separately organized research agency known as an experiment station desirable?" must be an unqualifiedly affirmative one. I am not now discussing the question of the geographical or administrative separation of the station from the college. That is an entirely different question to be answered from entirely different considerations than those which are proper to this paper. But what I do urge is that the agricultural research work of the land-grant college, for which federal and state appropriations are given in order that the practise of agriculture may be improved and the economic welfare of the people enhanced, shall be so definitely organized into a distinct entity (having for its sole purpose the promotion of research) that the environment most favorable to successful research work may be created. I do not need to enlarge upon the details of staff conferences; of cooperative work upon the project by the proper men, regardless of administrative departments of instruction; of freedom from interruption of thought and of work by other duties; etc., which contribute to this environment favorable to a high type of agricultural research. These are familiar to you all. I do wish, however, to urge upon the director of the station, in each case, the importance of the maintenance of a definite station staff with definite assignments to it and of definite staff activities as a highly important factor in developing the atmosphere or environment which I have been attempting to describe and which I believe to be an important factor in the future success of agricultural research work.

There is an additional problem in the administration of experiment station work upon the solution of which I believe its future possibilities depend in considerable measure. I refer to the effect which may be produced upon both the character and the method of our research by the present demand for so-called "practical results" from it. An inevitable and altogether wholesome reaction from the extravagance of war-time expenditure has set in. I hope that it may continue and that no object which does not promise definite improvement in our living conditions may successfully appeal for public financial support. I agree, therefore, that our expenditure of public funds for agricultural research must have as its proper justification the accomplishment of some definite "practical result." I believe, however, that a definite contribution to science which may make our structure of agricultural knowledge more complete, more sound, or even more beautiful, is a "practical" result of research work.

I have no patience with the dilatory browsing around in the field of the unknown in hopes that something interesting to the individual browser may turn up, which is sometimes lauded as "the search for truth for truth's sake," as a guiding principle in station research. I believe that each station project should be a definitely formulated effort to solve some problem which will contribute either to our knowledge of agricultural science or to our methods of agricultural practise. It is, of course, the second of these two types of contributions which is usually meant by the phrase "practical results," and contributions to agricultural scientific knowledge are regarded by some of our constituents as of doubtful desirability. I do not intend, however, to debate this particular point at length in this paper. I have indicated my own very definite convictions concerning it.

What I do wish to discuss, however, is the possible effect upon the methods of our research work of this continual pressure upon the station administration for so-called "practical results." This pressure may be either direct, in the form of active criticism

of the station's program of work by individual or organized farmers, or it may be the indirect and insiduous influence of the ability to cite definite financial benefits to the state or nation from the result of each completed project of station work, as a matter of pride in achievement or as an influence in securing future moral and financial support for the station's program.

Whatever the character of the pressure may be, it will be most unfortunate for the ultimate success of agricultural research in America if this pressure is allowed to influence the methods by which the station research is conducted. I believe it to be a cardinal principle of station research that the investigations shall be pursued according to the very best possible methods of scientific inquiry by a staff of investigators who are as well trained in these methods as it is possible to obtain. It is, of course, fortunate for the man himself if he has had such practical experience in farm operations as will lead him to see the possible applications and ramifications of his problem and such a back-ground of experience is an undoubted aid in the selection and formulation of a project to be undertaken; but, on the other hand, it may be a real handicap if it so prejudices him against certain methods of study as to limit his working tools of investigation, or if it gives him such pronounced preconceptions as to the probable outcome of the investigation as to unconsciously warp his observations or conclusions. From the standpoint of the successful prosecution of station research an open and unbiased mind and the ability to use skillfully all the working tools which are afforded by a proper knowledge of fundamental sciences, are, in my judgment, better qualifications for station research than is any amount of practical farm experience.

I am not discussing preparation for extension or teaching of agriculture; but preparation for agricultural research. I do not wish to appear to belittle the value of practical farm experience to any worker in scientific agriculture. I know what its value has been to me. Nor do I underestimate its value in contributing to the solution of many problems which come to the station to be answered. But there are hundreds, if not thousands, of farmers in every state who have a vastly better wealth of farm experience to bring to the solution of these problems than we could possibly get for our station men. They can, should, and do contribute the part to the improvement of agricultural practises which farm experience can teach. They can not contribute what scientific inquiry has to add to agricultural knowledge and it is this latter contribution which our stations should be organized to provide.

I have every confidence that the future has even greater opportunities and successes in store for the contributions of science to agriculture than the past has had, and I, therefore, close this paper with the utterance of my profound conviction that the present apparent slight reverse is but a temporary phase of the general problem of agricultural development in America, and that the outlook is for future opportunities which will challenge and stimulate our very best efforts to meet them.

R. W. Thatcher

New York Agricultural
Experiment Station,
Geneva

ZOOLOGICAL RESEARCH AS A CAREER

In the present state of the subject a person looking forward to a career in zoology must, in most cases, expect to find it in academic life. Here there are increasing opportunities leading out into special lines such as anatomy, physiology, genetics, histology, embryology, cytology, entomology, paleontology and in occasional cases into systematic work upon limited groups, such as fishes, reptiles, birds, mammals, molluscs, etc. The increased entrance requirements of professional schools, demanding scientific training, has led to larger numbers of students in the elementary zoological courses, thus making more teaching positions in colleges; while improved methods of instruction in anatomy, physiology, histology, and embryology have

opened up positions in medical faculties for trained workers in these subjects.

The history of a professor of zoology at present would run some such course as this. While an undergraduate he might show a special interest and ability in the subject leading to an appointment as assistant of some kind in the laboratory. Upon graduation he might receive a scholarship in the graduate school and later a fellowship, these various appointments making him somewhat self-supporting. Having obtained his Ph.D. degree and developed a special interest in some phase of zoology he could expect to be appointed an assistant or instructor taking part in the laboratory instruction of the elementary courses. After a time he would be given charge of a class in the particular subject in which he had specialized and with it the rank of assistant professor. After a number of years he would attain the rank of associate professor or its equivalent. Finally after a period of about fifteen years he might be made a full professor. During the preliminary years of his career his salary might range from $1,000 to $3,500 per year, while as full professor his income would be from $4,000 to $6,000. Within recent years salaries have advanced and in a few places reach from $8,000 to $10,000. While from the financial standpoint not much can be said for such a prospect there are many additional compensations which are worthy of consideration. Chief among these is the opportunity for constant mental growth and development, and the contact with young and inquiring minds which keeps the mind active and adaptable. Constant association with the best products of human thought, and with pleasant and congenial fellow-workers, together with opportunities for travel and study in the summer vacation constitute arguments of great weight for any one whose tastes incline to a scholastic life.

The added attraction of a career in a chair of science is that one deals with matters which are essentially of interest to our present civilization. The contributions made to human knowledge are now almost exclusively in science. Other civilizations have equalled or excelled us in many lines of endeavor, but in coming to an understanding of the real nature of ourselves and of the universe in which we live, we stand apart. An opportunity to take part in enlarging the bounds of human knowledge and in gaining control over the conditions of human existence must appeal to the imagination of any young man, who really has ambition to leave the world better than he found it. The teacher has the additional satisfaction of contributing to the forces that will continue the attack upon Nature's secrets because his students live after him.

Added to the attractiveness attaching to any scientific position the zoologist finds a compelling interest and satisfaction in studying living things and in learning from them secrets which profoundly affect his own existence. It is only necessary here to recall that Darwin, in establishing the theory of evolution, supplied a philosophy which has dominated every phase of human affairs in the last half century. Every year sees additions to our knowledge of life and its processes which make for a better and fuller human existence. The subject of zoology is so young and fertile that any capable person may hope to make a worthy contribution to it. Because of this he may well forego opportunities more attractive in a worldly way.

But should there exist a taste for scientific pursuits and a disinclination for scholastic life there are many ways in which a scientific training can be utilized outside the school room. The national government maintains extensive laboratories among which are those dealing with the applications of zoological knowledge. At present these are largely concerned with parasitological questions, but in the study of these there open up fascinating life histories of animals, and their pursuit involves travel and investigation in many lands. To one interested in fishes and their ways the Bureau of Fisheries offers many opportunities, some of which lead to ocean voyages and experiences with the mysteries of the sea.

The most extensive demand that the government makes, however, is for entomologists. Large numbers of such specialists are engaged in the study of insect life in all its aspects. A part of this work is done in the laboratories of the Department of Agriculture, but in many cases the field studies constitute a large proportion. Some of the investigations are of the most fundamental scientific value and there are projects for the exhaustive studies of life histories, such as, for instance, that of the honey bee. In this case several men give all their time to investigating, with excellent equipment, the complicated social and biological life of the hive.

As biological science grows, places are made in government departments to take advantage of the latest developments. Within recent years the subject of genetics has undergone rapid development and some of the underlying laws of heredity have become known. To extend our knowledge of these and to make them applicable to animal breeding the Department of Agriculture has established special facilities for the study of genetics and has employed men to investigate breeding problems in the most comprehensive manner. Positions thus opened are very attractive to persons desiring to follow the career of an investigator unhampered by teaching responsibilities.

The states now are also setting up laboratories which require trained zoologists. These may be in their universities and colleges or may be connected with public health departments, biological surveys, entomological commissions, or museums. Among them they offer some variety of choice but, in general, are distinguished from teaching positions by greater contact with the general public and by a larger element of administrative or regulatory work.

Similarly, large cities have established departments of public health in which there is occasional demand for zoologists, principally in entomological or parasitological studies. In some cities also there are municipal museums and zoological gardens which require zoologists trained as collectors, field naturalists and systematists in different groups. Sometimes these positions are very attractive.

Finally there are research institutions on private foundations where opportunities for zoological investigators are of the highest character. The development of these has been due largely to the failure of universities to make adequate provision for research. The rapid growth of science and the expensive equipment required for investigational work, together with the necessity of providing plenty of unhampered time for the student of new problems, has made inevitable and necessary the establishment of research institutes. Since these are well-endowed they offer attractive openings for thoroughly trained zoologists.

C. E. McCLUNG
UNIVERSITY OF PENNSYLVANIA

GEOLOGY AS A PROFESSION

INTRODUCTION

"THE geological book—the greatest historical document of the ages . . .," these are the words of one worker after thirty active years of teaching and research. Are the attractions of geology really such that able young men of to-day may expect to be led to similar enthusiastic exclamation after their initiation into the science? To answer this question is the purpose of this paper.

RELATION TO OTHER SCIENCES

The first point which should be understood is that a liking for chemistry, physics, biology, mathematics, astronomy, or economics, excludes no one from becoming a geologist. Geology is not truly an independent science; it is a combination of other sciences directed towards a specific field of study—the earth. One of the greatest deterrents to more rapid progress in geology is the lack of broad training in other sciences; a professor of geology in a well-known university recently remarked that he would rather teach a graduate student well-grounded in other sciences and knowing little geology, than one well trained in geology and knowing little of other sciences. The fact that geology is in many ways not one of the exact sciences by no means indicates that a foundation in these is

not desirable. Many ridiculous hypotheses have been advanced in geologic theory which would never have escaped their authors' minds had some knowledge of the more exact sciences been there to hold their fancies in check. Many of the problems at present most obviously open for investigation are those on the borderland between geology, and physics or chemistry. This matter is stressed because many brilliant students are repelled from geology because of the number of questions to which "probably" or "perhaps" are the only safe answers. The converse of this is also true, that many men with a love of science have been attracted to this field for the very reason that the personal equation can enter in; and by their gifts of accurate observation, deduction and induction, such men have been able to make most important contributions.

OPPORTUNITIES IN GEOLOGY

Without attempting to make geology a sort of scientific catch-all, it is, nevertheless, evident that there is room for men of very diverse scholastic leanings. The same is true for occupational preferences; there are governmental exploring parties whose range of work extends from Alaska to Mexico; there are expeditions to distant or unexplored regions for commercial companies; there are state surveys in 41 of the 48 states; there is the teaching profession; and there is museum work. Lastly, there are opportunities in various endowed institutions, in some museums, and a few universities, for uninterrupted research. Geology not only appeals to men of diverse scientific tastes, but offers each a livelihood in the field of his choice.

POSSIBLE LINES OF INVESTIGATION

Some types of geologic investigation are described below:

First, there is investigation on the borderland between physics, chemistry, and to a certain extent astronomy, and geology. A good idea of the type of problem attacked in this field may be obtained from the list of publications of the Geophysical Laboratory of the Carnegie Institution. Here are such headings as:

Contributions to Cosmogony and the Fundamental Problems of Geology. The Tidal and Other Problems.

An Investigation into the Elastic Constants of Rocks . . .

Significance of Glass-making Processes to the Petrologist.

Methods of Petrographic Microscopic Research.

If a more detailed picture of the overlap of geology and chemistry is desired, the student need only glance through "The Data of Geochemistry," Bulletin 616, United States Geological Survey, where the almost endless inter-ramification of the two sciences is well illustrated.

Second, there is that great mass of research on the borderland between biology and geography. Types of recent topics are:

The Fossil Turtles of North America.

Iron-bearing Bacteria and their Geologic Relations.

Human Remains and Associated Fossils from the Pleistocene of Florida.

Distribution of Fossil Plants in Time and Space.

Such investigations have been carried out under the auspices of government museums, privately endowed museums, privately endowed research institutions, the United States Geological Survey, State Geological Surveys, and universities, and by teachers utilizing their spare time for independent research.

Third, there is the decided trend of many geologists toward research on the borderland between geology and economics, a useful field if competently filled. Of a recent book "Coal, Iron and War," written by a geologist, a reviewer has said that it "cuts under political and social facts" to the material influences which create them.

Fourth, there is research in commercial geology. There are two classes of commercial workers—the consulting geologist and the geologist in the employ of a single company. The first to a certain extent controls his time and has opportunity to devote considerable

energy to research. Such men have taken an active part in the development of their phase of geology and have made many valuable contributions to the subject. Those employed by a definite company have less control of their time and therefore less independence in the direction their studies take. In both cases the research is likely to contain an element of secrecy—and results of research which can not be published, no matter how good they may be, can not contribute to the advancement of the science. Recent studies show an actual decrease of published matter occurring at just about the time the call for oil geologists became pronounced. This is no indication that geologists should not go into professional geologic work, but it does point out that if a man feels he would enjoy the publication of the results of his research, there are far better openings than commercial work in his particular case.

There seems to be no need of discussing the various fields of what is more commonly considered geology. The sources of support are the same as above and the opportunities for subjects of study as endless as the topics of the text-books. Stratigraphy, physiography, economic geology, dynamical, and historical geology, with their accompanying theoretical aspects, all offer their attractions according to the taste of the investigator.

COMPENSATION

Compensation is unquestionably of two sorts—material and mental. In material compensation, there can be no doubt that the practising geologist leads. He also has the satisfaction that comes from active participation in the development and winning of material wealth. There is, however, a field of research where the results are not utilitarian and are of no apparent practical value. Here the financial reward is less, but there comes instead what to many men is the greatest joy of life—the personal discovery of new facts and the increase of human knowledge. A geologist said recently "I am doing just what I would do if I had a million dollars." The true research spirit has in it also an underlying motive of service to humanity. The reading of biography or personal observation will surely verify this statement.

> Great advances of the future are not dependent upon having every man do everything as an expert, but they will rest upon a wide appreciation of the importance of constructive thought, of organized knowledge, and of the continuous advance of knowledge.[1]

If a man's inclination is to add to this "continuous advance of knowledge" by personal effort, he may be sure that he will eventually feel well paid.

GEOLOGY AS A PROFESSION[2]

Why enter geology as a profession? The reasons are most diverse and will make varying appeals according to the likes and dislikes of the individual. No claim is made that the facts advanced are all peculiar to geology, but the combination of advantages is certainly hard to match elsewhere.

For the sake of clarity these reasons will be discussed under numerical headings.

1. *The science is young.* Any man of good ability may hope to make worth while contributions to it. The joy of discovery, already alluded to, is open to all.

2. *The range of possible employment is large.* The three most open to the beginner are teaching, work under government or state bureaus, and commercial employment. If one type of work proves distasteful, there are opportunities to utilize the same training in a different occupation. This fact has been amplified on a preceding page.

3. *The investigator may feel that his work has an intimate relation with the winning and best utilization of the raw materials which contribute to national and world prosperity.* This is often true even if his tastes lead him in fields which seem to have no relation to the practical needs of man. Berry,

[1] Address by J. C. Merriam. See Science for November 19, 1920.

[2] The writer wishes to acknowledge indebtedness to a splendid paper by R. D. Salisbury, in Science, April 5, 1918, for much that is good in the following discussion.

in reviewing a recent work on foraminifera, has pointed out that these microscopic animals "have lately been shown to be of profound significance in the location of oil sands . . . in the Texas oil fields."

4. *The geologist has the pleasure of realizing close bonds with many kinds of people and many fields of human interest.* The successful operation of the federal leasing law depends on the work which many young geologists have been doing in the different sections of the country in past summers. In the settlement of post-war problems in economics, the word of the geologist (and geographer) carried much weight. In matters of conservation and the establishment of national parks he holds an honorable place. And his influence on religious thought has been and still is great.

Geology means contact with people. The geologist in his field work often meets woodsmen, Indians, cowboys, pioneer agriculturalists, prospectors and miners; in consulting work, he deals with "big business"; in classroom or office, with highly trained university men; often his lot is cast with all three types many times in the course of a year. He must develop tact, an understanding and appreciation of people of various kinds, and an ability to adapt himself to varying conditions of life. Incidently, he will probably keep alive the "milk of human kindness." Geology may not be a humanistic subject, but it is a thoroughly human subject.

5. *The character of the science is such as to develop the quality of good judgment.* Geology being young and many theories still debatable, the first duty of the geologist is to consider the evidence and accept those theories according best with the known facts. Due, perhaps, to this and the preceding fact, many geologists have filled positions as college presidents, executive officers, and public servants with exceptional tact, skill, and integrity.

6. *The geologist derives great reward from his intimate understanding of nature.* No journey is so long, no desert so drear, no mountain so forbidding, no streamlet so small, no life so insignificant, that it does not bring with it some intimate revelation and fellowship. As is often said of religion, this is something which needs to be experienced to be understood. It is a wonderful possession to have and a wonderful gift to impart to others as teacher and as investigator. The geologist may not express his thoughts in a "Psalm of Life" as did Longfellow after viewing a fossil foot-print, but his inspiration may be even greater from his fuller understanding of its meaning.

7. *Geology is an invigorator—physically.* The researches of the active geologist will take him into the open, far away from the contaminated air of city and laboratory, for several weeks or months, each year. Few other learned professions can offer this inducement to their votaries. The geologist must love the out-of-doors and from this love he will draw physical fitness. Geology is pre-eminently a profession for the red-blooded, athletic type of man.

8. *Geology is an invigorator—morally and spiritually.* Consider the title of papers by some of the present-day leaders—J. M. Clarke, "The philosophy of geology and the order of the state"; T. C. Chamberlin, "A geologic forecast of the future opportunities of our race"; G. O. Smith, "Geology and the public service"; read the concluding paragraphs of text-books on geology; consider the closing words of a recent address before an important gathering of geologists—

> The student of earth sciences was once a contributor to the wider philosophy of nature. It may be his duty now to make sure, not only that his influence is felt in advancement of material welfare, but that he serve also to point out the lesson of the foundations of the earth, and to show that strength may still come from the hills.

In conclusion, for one who has scientific leanings, who cares for investigation, and who has ability, geology offers health, an optimistic outlook on life, human intercourse, abundant opportunity for research, and withal, a livelihood.

H. P. Little
National Research Council

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE AUTUMN MEETING OF THE EXECUTIVE COMMITTEE OF THE COUNCIL

THE meeting was called to order in the office of *The Science Press*, in the Grand Central Terminal Building, New York City, at 3 o'clock, November 20, 1921, Chairman Flexner presiding. The following members were present: Cattell, Fairchild, Flexner, Howard, Humphreys, Livingston, MacDougal, Moore, Osborn, Ward. Excepting A. A. Noyes, the entire committee was present.

1. The minutes of the last meeting (April 24, 1921) were approved as mailed to all members of the committee.

2. The permanent secretary's report was considered in some detail and was accepted and ordered filed. A résumé follows:

The Summarized Proceedings was published October 10. The membership list was closed June 15, so that the published list is corrected only to that date. 2,300 copies were printed at a cost of $5,378.58. The preparation of the manuscript cost $1,313.73 as extra clerical expenses. Adding this amount to the cost of publication gives $6,692.31. This total cost of the book is partially offset by sales of 1,796 copies amounting to $2,183.00. The book thus cost the Association $4,509.31 net, chargeable against the seven years, 1915 to 1921. 130 copies were given away, of which 74 went to general officers, section secretaries, and secretaries of affiliated societies, for their official use. Of the remaining 56 free copies, 53 were complimentary to institutions and libraries outside of the United States, and 3 copies were sent out on account of exchanges.

Three Booklets were printed and circulated since the last meeting of the executive committee. By means of one of these the *resolutions* recently adopted by the Association were placed in the hands of all members. About 12,500 copies of that booklet were sent out. *A booklet of general information* was used in the circularization for new members (about 25,000 have been sent out), and another *booklet announcing the Toronto meeting* was sent to all members with the bills of October 1.

New members of the affiliated societies and all members of the newly affiliated societies (The American Mathematical Society, The Mathematical Association of America, The American Geographical Society, The American Society for Testing Materials, The American Society of Agronomy, The Society of Sigma Xi, and the Gamma Alpha Graduate Scientific Fraternity) were invited to join the Association without entrance fee, as far as the necessary lists could be procured. About 20,000 such invitations have been sent out and about 10,000 more will go out when the lists arrive from the society secretaries. 4,300 names for circularization were obtained from the new volume of "American Men of Science." (To Nov. 20, this circularization—of about 24,300 names—has secured 557 new members.) A tabulated membership report will be published later.

3. The general secretary's verbal report was accepted. He reported correspondence with the Utah Academy of Science. This Academy has altered its movement for separation from the Pacific Division. He had been in consultation with officers of sections, and it was believed that stronger council sessions would result at future meetings. He reported that arrangements were being made by which various different interests have been centered in the program of Section C for the Toronto meeting.

A recess, from 6:30 to 8:00, was taken for dinner, after which the committee convened again.

4. Mr. J. B. Tyrrell was elected chairman of Section M and vice-president for that section.

5. Mr. L. W. Wallace was elected secretary of Section M.

5a. Dr. A. B. Macallum, professor of biological chemistry at McGill University, was elected a vice-president, and chairman of Section N.

6. Fifty-six fellows were elected, distributed among the sections as follows:

A	B	C	D	E	F	G	M	O	Q
6	3	3	1	4	19	3	2	14	1

7. The American Society of Mammalogists was constituted an affiliated society.

8. It was voted that the American Ceramic Society be invited to become associated and to become affiliated if the number of A. A. A. S. members in the society should prove to warrant affiliation.

9. The Phi Delta Kappa Fraternity was invited to become an associated society.

10. The Canadian Society of Technical Agriculturists was invited to become an associated society.

11. The petition of 32 members resident in State College, Pa., dated November 1, was granted, thus constituting a local branch in that place, to be known as the State College (Pa.) Branch of the A. A. A. S. The branch is to receive 50 cents for each payment of annual dues made to the A. A. A. S. by its members.

12. It was voted that the committee regards it as

desirable that the next volume of Summarized Proceedings be published in fall of 1925, to include the proceedings of the 1924 (Washington) meeting.

13. It was voted that the executive committee recommend to the Council that the 1925 meeting (for the year 1925–6) be held at Kansas City, Mo.

14. The general secretary was instructed to communicate with the Pacific Division and to say that if the Pacific Executive Committee arranged its summer meeting for 1922 in Salt Lake City, the executive committee would consider the matter of arranging a meeting of the whole Association for that time and place.

15. The permanent secretary was instructed to invite all past presidents to be present at the Toronto meeting, especially to attend the sessions of the council at Toronto and to take part in the council's deliberations.

16. The general secretary was asked to invite one or more Russian scientists to attend the Toronto meeting.

The meeting adjourned at 10 o'clock, to meet in Toronto, at 10 A.M. on Tuesday, December 27.

Burton E. Livingston,
Permanent Secretary

EDUCATIONAL EVENTS

AN AMERICAN BAMBOO GROVE OPEN TO INVESTIGATORS

Research men connected with the state and other institutions are invited to visit the bamboo grove at Savannah on the Ogeechee Road. This grove covers an acre of ground, and the culms rise fifty-five feet into the air, producing a dense forestlike effect with their smooth dark green culms three and four inches in diameter. It is the largest grove of the Madane bamboo (*Phyllostachys bambusoides*) east of the Mississippi and comparable in beauty to groves of similar size in Japan. Any botanist who has never seen a bamboo grove has waiting for him a thrilling experience, for the sight of a giant grass over fifty feet tall changes one's ideas of grasses just as the sight of a victoria regia changes one's ideas of water lilies or the discovery of the pterodactyl changed our ideas of lizards and birds. A simple laboratory, which is being equipped with limited living accommodations, stands in the center of the grove, and its facilities are at the disposal of the research workers of the Department of Agriculture and other institutions upon application to this office.

While the grove is wonderfully interesting at any time, it is peculiarly fascinating about the middle of April when the new shoots four inches in diameter are coming through the ground and shooting skyward at a great rate.

Botanists to or from Florida should by all means stop and see this grove. It lies twelve miles from Savannah on a new concrete highway, the Ogeechee Road. Long distance telephone central will connect anyone with the "Government Bamboo Grove," and they can talk with Mr. Rankin, the superintendent.

David Fairchild

Office of Foreign Seed and Plant Introduction,
Bureau of Plant Industry

FLIGHTS OF HOUSE FLIES

That the house fly not uncommonly makes a journey of five to six miles in the space of twenty-four hours is shown by experiments conducted by the Bureau of Entomology, United States Department of Agriculture. The ease with which flies travel many miles shows the importance of general sanitary measures to destroy breeding places. Fly flight tests were conducted in northern Texas, where approximately 234,000 flies of many different species were trapped, then dusted with finely powdered red chalk, and liberated. Fly traps baited with food highly relished by the flies were placed at measured intervals in all directions from the points of release. By means of these secondary traps, it was possible to determine the direction and flight of different species of flies. The tests showed that the flies, after regaining their freedom, would travel distances up to 1,000 feet in a few minutes. The screw-worm fly evidenced its power to cover a half mile in three hours, while the black blowfly traveled anywhere from half a mile to eleven miles during the first two days' release. The house fly covered over six miles in less than twenty-four hours. Observations at the Rebecca Light Shoal off

the coast of Florida seemed to show that flies come down the wind from Cuba (ninety miles distant), and at times from the Marquesas Keys (twenty-four miles distant), and even from Key West, Fla., forty-six miles away. The maximum distance traveled by the house fly in these experiments was 13.14 miles. The tests proved that the injurious forms of fly life were not distributed on any large scale by artificial means, but rather that many of the far-flying species showed marked migratory habits.

IMPACT ON BRIDGES

A NEW instrument devised by the Bureau of Public Roads of the United States Department of Agriculture measures with scientific precision the effect of every shock and blow delivered by moving vehicles in crossing a bridge. Attached to any part of the bridge structure, this instrument makes a photographic record of the effect of the moving load. The amount of stretching or shortening of the part as a result of the shocks is represented by a fine black line on the photograph. No blow or shock can be delivered so quickly that the instrument will not record its effect. It has never before been possible to measure the effect of such blows. Engineers have long been able to calculate the effect of standing loads very exactly; but because of their inability to measure the effect of quickly delivered blows or impacts, they have never been able to proportion the various parts of a bridge with absolute assurance. It has been necessary to make a liberal allowance for this unknown quantity. In some cases the allowance has not been sufficient and the bridges have collapsed under moving loads. Many bridges still in service are probably too weak to withstand safely the sharp blows of swiftly moving vehicles, though they will safely carry the same vehicles at rest or moving at a slow speed. The familiar warning posted at the portals of a bridge: "Speed limit on this bridge 8 miles per hour," means that the design of the bridge to which it is attached is not strong enough to allow for impact. In the light of the recent experiments with motor trucks in which it was shown that a swiftly moving motor truck may strike a blow equivalent to seven times its actual weight, it is rather surprising, the department road experts say, that failures have been so few. It is believed this new measuring instrument will soon do away with uncertainty. The knowledge gained by its use will enable the engineer to design bridges which are sure to hold up under fast-moving vehicles, and to build such bridges without undue waste of material and money.

THE TORONTO MEETING

THE section of medical sciences of the American Association has arranged the following program:

Vice-presidential Address: "The past and the future of the medical sciences in the United States": Professor Joseph Erlanger, professor of physiology, Washington University.

"Hereditary factors in development": Dr. Charles B. Davenport, director of the Laboratories for Experimental Evolution of the Carnegie Institution.

"The metabolism of children in health and disease": Professor Harold Bailey, Cornell Medical School, N. Y.

"Newer aspects in dietetics of children": Dr. Alfred Hess, College of Physicians and Surgeons, New York.

"Movie exhibition of tonsil-adenoid clinics in operation": Dr. George W. Goler, health officer, Rochester, N. Y.

"The mental hygiene of children": Dr. C. M. Hincks, associate medical director, Canadian National Committee for Municipal Hygiene, Toronto, Canada.

PROFESSOR E. S. MOERE, secretary of the section of geology and geography, writes:

The section has prepared a very interesting program for the Toronto meeting and the officers of the section will be glad to hear at once from any of the members who wish to contribute. While the meetings of the other societies affiliated with the association are drawing many of the geologists and mineralogists from this side of the international boundary to Amherst, quite a number are going to take part in the Toronto meeting and the Canadian geologists are most heartily cooperating in preparation for the meeting. Many of the geologists of the Canadian Geological Survey and

of the Canadian universities have prepared papers and some of them dealing with new geological fields will be of special interest. Dr. Eliot Blackwelder, at present at Harvard University, will deliver his address as retiring vice-president of this section on "The trend of earth history." It is intended that the geological and engineering sections will combine for a banquet.

The second meeting of geneticists interested in agriculture will be held at Toronto, on Tuesday, Dec. 27.

The program will take up "The genetics curriculum in the college of agriculture." Discussion of various phases of the subject will be opened as follows: (1) The elementary course in genetics. Prof. C. B. Hutchinson, Cornell University. (2) Advanced courses in genetics. Prof. J. A. Detlefsen, University of Illinois. (3) Laboratory courses in genetics. Prof. A. C. Fraser, Cornell University. (4) Genetics preparation for research in other fields. Dr. E. D. Ball, U. S. Department of Agriculture. Invitation to attend and to participate in the discussions is extended to all who may be interested, whether or not they are connected with agricultural institutions, since the topic really comprehends the general subject of genetics teaching. It is hoped to have a good attendance of those concerned with the teaching of applied courses in plant and animal breeding.

SCIENTIFIC NOTES AND NEWS

Henry Turner Eddy, professor emeritus of mathematics and mechanics in the University of Minnesota and dean emeritus of the graduate school, died on December 18 at the age of seventy-seven years.

Dr. Ernest Fox Nichols, who recently resigned the presidency of the Massachusetts Institute of Technology, is to return to Cleveland to resume the directorship of pure science in the Nela Research Laboratory, maintained by the National Lamp Works of the General Electric Company.

Stevens Institute of Technology held a fiftieth anniversary banquet at the Hotel Astor, New York City, on December 15. A silver loving cup was presented to Professor Charles Kroeh, secretary of the faculty, who has been professor of modern languages at Stevens ever since it was founded. The speakers were Dr. Alexander Humphreys, president, Dr. John H. Finley and Mr. Job E. Hedges.

The Howard N. Potts gold medal and diploma of the Franklin Institute have been conferred upon Alfred Q. Tate for inventions which have created the new art of electrolytic waterproofing of textile fabrics.

Philip L. Gile, formerly connected with the American Agricultural Chemical Company and for eleven years previously chemist of the Porto Rico Agricultural Experiment Station, has been placed in charge of the division of soil chemical investigations of the Bureau of Soils, U. S. Department of Agriculture.

Ralph Stone, member of the staff of the United States Geological Survey, has left the federal service to become assistant state geologist of Pennsylvania.

Mr. James E. Ives has resigned as research associate and lecturer in physics at Clark University to become physicist in the office of industrial hygiene and sanitation of the Public Health Service in Washington.

Dr. C. G. Abbot of the Astrophysical Observatory is at present in Antofagasta, Chile, at the solar radiation station on Mt. Montezuma. He expects to return in January.

C. H. Birdseye, chief geographer for the U. S. Geological Survey, left Washington on November 30, to inspect the map-making activities of the Survey in the West and in Hawaii.

J. W. Gilmore, professor of agronomy, College of Agriculture of the University of California, has returned from the University of Chile, Santiago, Chile. Professor Gilmore has been exchange professor with this university for the past six months. While in Chile he was in consultation with the Chilean authorities with a view toward improving the agriculture of the western coast of South America.

DR. MORTEN P. PORSILD, director of the Danish Arctic Station, Disko, Greenland, is at present in Copenhagen, Denmark, where he is making plans for a visit to England and America. In December and January he will lecture at the University of Cambridge, England, on botanical and ethnological subjects. He expects to reach the United States about the middle of February and may lecture at scientific centers.

DR. CLEMENT PIRQUET, Dr. Charles Wardell Stiles and Dr. Alfred F. Hess, have been appointed to give this year the Cutter Lectures on Preventive Medicine under the auspices of the Harvard Medical School. Dr. Pirquet is professor of pediatrics at the University of Vienna and is best known for his work on behalf of the under-nourished children of Austria since the war. Dr. Stiles is assistant surgeon general of the U. S. Public Health Service and consulting zoologist of the Bureau of Animal Industry in the Federal Department of Agriculture; Dr. Hess is a New York pediatrist.

DR. E. M. EAST, of the Bussey Institution of Harvard University, gave a series of lectures at Cornell University, December 8–10, 1921, as follows: "Problems of population in relation to agriculture," to the Society of Sigma Xi; "Inbreeding as a tool in plant improvement," to the staff and students of the College of Agriculture, and "The problem of self-sterility in plants," to the seminary of the department of plant breeding.

HENRIETTA SWAN JEWETT, of the Harvard College Observatory, died on December 19. Since 1902 she had been engaged in the study of the photographic brightness of the stars and the distribution and periods of variable stars.

THE Elizabeth Thompson Science Fund has been serviceable for many years in giving aid, by small grants, to research which otherwise might not be readily undertaken. The grants are made only for scientific investigations and must be applied to actual expenses of the research, *i.e.*, they are not made to support an investigator or to meet the ordinary expenses of publication. The trustees give preference to researches involving international cooperation. The grants are not made for researches of narrow or merely local interest, nor are they available for equipment of private laboratories or for purchase of apparatus ordinarily to be found in scientific institutions. Applications for grants from this fund should be made before January 15, 1922, to Professor W. B. Cannon, secretary of the trustees of the fund, Harvard Medical School, Boston, Mass.

THE Fifth National Medical Congress of Cuba, which takes place every five years, will be held from December 11 to 17, under the presidency of Professor J. A. Presno, founder and director of the *Revista de Medicina y Cirurgia* of Havana.

ADOLPH LEWISOHN has given $150,000 for the pathological laboratory of Mount Sinai Hospital, New York City. The gift is in addition to others to the hospital and laboratory made by Mr. Lewisohn, including a similar amount for the laboratory.

THE Committee of the Universities' Library for Central Europe, formed in England to renew the stocks of books and scientific and learned periodicals in the universities of Central Europe, has recently issued its report for its first year of working, ending March 31, 1921. It has sent consignments of literature to Austria, Czecho-Slovakia, Esthonia, Germany, Hungary and Poland. Donations of money and English books published since 1914 are still urgently needed, and may be sent to the honorary secretary, Mr. B. M. Headicar, London School of Economics, Clare Market, W. C. 2.

THE Sarah Berliner Fellowship for research in physics, chemistry or biology is now of the value of from one thousand to twelve hundred dollars. In view of the fact that some of the holders of this fellowship have given important courses of lectures at Cornell, the Johns Hopkins, Yale and other universities, the committee in charge of the fund has decided to give explicit recognition to this aspect of the fellowship. Hereafter, therefore, preference will be given those candidates who can carry on research and at

the same time have the privilege of giving one or more courses of lectures at some university or institution of learning.

UNIVERSITY AND EDUCATIONAL NEWS

President Angell has announced that Mrs. Stephen V. Harkness of New York is the hitherto unnamed friend of the University whose conditional gift of $3,000,000 was made public by President Hadley at the Commencement alumni dinner in 1920. Mrs. Harkness's gift of $3,000,000 was made conditional upon the securing of an additional $2,000,000 from alumni and other friends which was pledged on October first, 1921. In her original letter of gift, dated April 5, 1920, Mrs. Harkness stated: "I am informed that Yale University has recently increased the salaries of the members of its several faculties. . . . This action seems to me to be in accord with the general feeling of its alumni and friends, that those who are devoting their lives, with little or no opportunity for large pecuniary rewards, to the teaching of young men and women and the moulding of their characters and opinions, should receive so far as possible a compensation sufficient always to attract persons of ability and standing."

Earl B. Young has been elected professor of geology at the Montana School of Mines, Butte, Mont.

DISCUSSION AND CORRESPONDENCE

THE NATIONAL ACADEMY OF SCIENCES AND THE METRIC SYSTEM

To the Editor of Science: The National Academy of Sciences at its meeting in Chicago in November, on request, considered the bill introduced in the Senate by Senator E. F. Ladd, which reads as follows:

67th Congress,
1st Session

S. 2267

IN THE SENATE OF THE UNITED STATES
July 18, 1921

Mr. Ladd introduced the following bill; which was read twice and referred to the Committee on Manufacturers.

A BILL

To fix the metric system of weights and measures as the single standard of weights and measures for certain uses

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after ten years from the date of passage and approval of this Act the weights and measures of the meter-liter-gram or metric system shall be the single standard of weights and measures in the United States of America for the uses set out herein.

Sec. 2. That the national prototypes of the fundamental standards of the metric system shall be the copies of the standards known as meter numbered twenty-seven and kilogram numbered twenty, allotted to the United States by the General Conference of Weights and Measures held at Paris in 1889. These are now deposited in the vault of the Bureau of Standards of the Department of Commerce and those which are now used and employed in deriving the values of all weights and measures used in the United States. These national representations are hereby adopted as the primary standards of weights and measures for the United States of America, and from these all other weights and measures shall be derived and ascertained.

Sec. 3. That from and after ten years from the date of passage and approval of this Act no person shall do or offer or attempt to do any of the following acts, by weights or measures, in or according to any other system than the metric system of weights and measures, namely:

(1) Sell any goods, wares, or merchandise except for export, as provided in section 8;

(2) Charge or collect for the carriage or transportation of any goods, wares, or merchandise.

Sec. 4. That from and after ten years from the date of passage of this Act no person shall use or attempt to use in any of the transactions detailed in section 3 any weight or measure or weighing or measuring device designed, constructed, marked, or graduated in any other system than the metric system of weights and measures.

Sec. 5. That not later than ten years from the date of passage and approval of this Act all postage, excises, duties, and customs charged or collected by weights or measures by the Government of the United States, shall be charged or collected

in or according to the metric system of weights and measures.

Sec. 6. That rules and regulations for the enforcement of this Act not inconsistent with the provisions hereof shall be made and promulgated by the Secretary of Commerce. The Secretary of Commerce shall also take such steps as he may deem expedient for giving publicity to the dates of transition specified herein and for facilitating the transition to the meter-liter-gram or metric system.

Sec. 7. That all Acts or parts of Acts inconsistent herewith are hereby repealed but only in so far as they are inconsistent herewith; otherwise they shall remain and continue in full force and effect. Whenever in any Act, or rules and regulations, or tariff or schedule made, ratified, approved, or revised by the Government of the United States of America weights or measures of the system now in customary use are employed or referred to, and to comply with the provisions of this Act weights and measures of the metric system should be employed, then such references in such Act, rules and regulations, tariff, or schedule shall be understood and construed as references to equivalent weights or measures of the metric system ascertained in accordance with the required degree of accuracy.

Sec. 8. That nothing in this Act shall be understood or construed as applying to—

(1) Any contract made before the date at which the provisions of this Act take effect;

(2) The construction or use in the arts, manufacture, or industry of any specification or drawing, tool, machine, or other appliance or implement designed, constructed, or graduated in any desired system;

(3) Goods, wares, or merchandise intended for sale in any foreign country, but if such goods, wares, or merchandise are eventually sold for domestic use or consumption then this clause shall not exempt them from the application of any of the provisions of this Act.

Sec. 9. That nothing herein shall be understood or construed as prohibiting the enactment or enforcement of weights and measures laws or ordinances by the various States or cities, and the various States or cities shall have the same powers as though this Act were not in force and effect: *Provided, however,* That no standard weights or measures shall be established for the uses set out herein which conflict in any way with the standards established herein, and such standards which may already have been established shall be null and void for the uses set out herein.

Sec. 10. That the word "person" as used in this Act shall be construed to import both the plural and singular, as the case demands, and shall include corporations, companies, societies, and associations. When construing and enforcing the provisions of this Act, the act, omission, or failure of any officer, agent, or other person acting for or employed by any corporation, company, society, or association, within the scope of his employment or office, shall in every case be also deemed to the act, omission, or failure of such corporation, company, society, or association as well as that of the person.

After discussion, the bill was referred to the Committee on Weights, Measures, and Coinage of the Academy for report, with power to act through the President of the Academy. Upon receipt of the report from the Chairman of that Committee, Dr. Thomas C. Mendenhall, the following communication was sent to Senator Ladd:

December 1, 1921

My dear Senator Ladd: Referring again to my recent communications regarding bill S2267 to fix the Metric System of Weights and Measures as the single standard for certain uses, I have received a report from the Committee on Weights, Measures, and Coinage, which was authorized to act for the National Academy of Sciences, approving bill S2267 with the following statement:

"Any measure that might now be passed is tolerably certain to need modification and amendment before the end of the probationary period."

Very truly yours,

(Signed) Charles D. Walcott,
President

As Senator Ladd has requested that publicity be given to this action of the Academy, I am sending you this statement for inclusion in Science.

Charles D. Walcott,
President

STAINS FOR THE MYCELIUM OF MOLDS AND OTHER FUNGI

To the Editor of Science: Microscopic examinations to determine the extent to which the mycelium of various fungi has penetrated infected specimens of wood consume an unduly large amount of time. Methods using organic substances, dyes and stains, to obtain a differ-

ential coloring that will make mycelium stand out in contast to the tissue of the host have been described.[1]

The writers, in an attempt to obtain a stain which would reduce the time required for the examinations of a set of woods infected with molds by producing satisfactory differentiation both for visual examination and for photomicrography, have worked out the following method. The results, although the work is only in the preliminary stage, are so promising that they are given here in order that others may avail themselves of the method if they desire to do so.

Since there is a difference in chemical composition between wood substance and chitin or "fungous cellulose," the assumption was made that the fungous mycelium might possess characteristic mildly oxidizing or reducing properties. Then a solution of silver nitrate in distilled water was applied to thin sections of the infected wood. These were allowed to stand for periods of various lengths, overnight staining giving a very satisfactory result. The sections were then examined directly or dehydrated with alcohol, cleared with xylol, and mounted in Canada balsam. Drying the balsam mounts under weights in an oven over night appeared, if anything, to improve the stain secured.

Both conifers and hardwoods were treated in this way. The mycelium of several molds and of two wood-destroying fungi has thus far been stained. In all cases the mycelium was differentiated by its blackish brown, purplish brown, or orange color. The wood tissue presented, if stained, a lighter shade of yellowish brown against which the mycelium was readily visible, often under relatively low magnifications.

Silver nitrate solution also gave interesting staining of the wood structures and cell contents which will be discussed at some future time.

Gold chloride solution, and the "Berlin Blue" stain, the latter as described by Dr. Sophia Eckerson in her course in microchemistry,[2] were also used with some success for the same purposes as the silver nitrate.

M. E. Diemer,
Chemist,
Eloise Gerry,
Microscopist
Forest Products Laboratory,
U. S. Department of Agriculture,
Madison, Wisconsin

[1] Sinnott, E. W. and I. W. Bailey, *Phytopath.*, 4: 403, 1914. Vaughan, R. E., *Ann. Mo. Bot. Gard.*, 5: 241, 1914 and others.

[2] Text-book now in preparation.

SHARKS AT SAN DIEGO

To the Editor of Science: It has occurred to the writer that a very brief statement of some experiences in collecting shark material at San Diego, Cal., in 1920–21 might be of value to persons interested in research problems in elasmobranch morphology and embryology. Owing to the fact that the reduction plants in San Diego paid in 1920–21 a price for sharks high enough to make it worth while for the fishermen to bring in all such material caught incidentally, and since nearly all such material was brought to the fish-market pier, at the latter place it was possible in a very short time to collect a considerable range of species. The writer obtained twenty-six species of elasmobranchs at San Diego, and the embryos of fourteen of them. No other place along the Pacific coast, or probably on any other coast, offers such a wealth of material and such easy access to it. It was not uncommon to see fifteen species of elasmobranchs at one time on the pier at San Diego.

H. W. Norris
Grinnell College

MUNICIPAL OBSERVATORIES

To the Editor of Science: In Science for August 5, the Municipal Observatory at Des Moines is "said to be the only municipal observatory in the world." The Cincinnati Observatory was incorporated in 1842, its corner stone being laid in 1843 by John Quincy Adams. Here Cleveland Abbe (director '68–'73) first issued daily weather reports and laid the foundation of the U. S. Weather Bureau. In 1872, the property was transferred to the University of Cincinnati (municipal) on condition that the city sup-

port the observatory, which has since been done. The observatory now receives by law the income of a tax levy of one twentieth of a mill.

Nevin M. Fenneman
University of Cincinnati,
December 2, 1921

SCIENTIFIC BOOKS

THE ORDER OF NATURE

The Principles of Natural Knowledge, by A. N. Whitehead, Cambridge University Press, 1919.

L'Unité de la Science, by Leclerc du Sablon. Félix Alcan, Paris, 1919.

The Order of Nature, by Lawrence J. Henderson. Harvard University Press, 1917.

The System of Animate Nature, by J. A. Thomson. Two volumes. Williams and Norgate, London, 1920.

In the first dialogue between Hylas and Philonous Berkeley has the latter to say: "I am not for imposing any sense on your words: you are at liberty to explain them as you please. Only, I beseech you, make me understand something by them." The author of "The Principles of Natural Knowledge" has obviously had before him not only this demand, which he sets forth by giving the foregoing quotation on his title-page, but also the further one that every intelligent reader shall understand the same things by his words. Neither of these ideals is easily realized in philosophical writings; and this is most emphatically true of those which are addressed to readers not interested in the technical aspects of philosophy. Why does this difficulty exist? "We have to remember that while nature is complex with timeless subtlety, human thought issues from the simple-mindedness of beings whose active life is less than half a century."

The author seeks to realize clarity by the so-called "method of logical atomism" which "has gradually crept into philosophy through the critical scrutiny of mathematics" and in his discussion to substitute "piecemeal, detailed and verifiable results for large untested generalities recommended only by a certain appeal to the imagination," to use Bertrand Russell's characterization of the philosophy of logical atomism. Whitehead analyzes thought into elements which the unsophisticated mind could never recognize as parts of its original thought content; and sometimes even for the expert, one must believe, there is real difficulty in putting together the parts so as to recover the whole. But the reader is not in doubt as to what the author says or what he means. Whitehead says:

"The fundamental assumption to be elaborated in the course of this enquiry, is that the ultimate facts of nature, in terms of which all physical and biological explanation must be expressed, are events connected by their spatio-temporal relations, and that these relations are in the main reducible to the property of events that they contain (or extend over) other events which are parts of them." Time is not a succession of instants. but a complex of interlocking events, each helping to tie the others to the past and the future. "The conception of the instant of time as an ultimate entity is the source of all our difficulties of explanation. . . . Our perception of time is as a duration."

The work as a whole contains a somewhat technical and rather disjointed analysis of four matters, namely: the traditions of science; the data of science; the method of extensive abstraction; the theory of objects. The book will have its greatest appeal to the reader of considerable mathematical maturity, even though it does not at all depend on mathematical detail; for the point of view is evidently taken in the light of the recent philosophy of mathematics.

In "L'Unité de la Science" by M. Leclerc du Sablon we have an equal clarity, but it differs from that of Whitehead's work in being strongly marked by French characteristics.

In his preface Whitehead says: "In matters philosophic the obligations of an author to others usually arise from schools of debate rather than from schools of agreement. Also such schools are the more important in pro-

portion as assertion and retort do not have to wait for the infrequent opportunities of formal publication, hampered by the formidable permanence of the printed word. At the present moment England is fortunate in this respect. London, Oxford and Cambridge are within easy reach of each other, and provide a common school of debate which rivals schools of the ancient and medieval worlds." The authors of the first and last books under review have evidently profited much by such frequent interchange of opinion and this matching of judgment to opposed judgment. Doubtless some parts of the other two books would have been modified if their authors had more freely discussed certain controversial points with persons of a different opinion. This applies particularly to the philosophic aspects of the books, but does not affect their more positive contributions.

The philosophical part of "L'Unité de la Science" is not strong. It is sometimes naïve. In particular, the psychological theory underlying the first chapter is far from being satisfactory. But numerous scientific theories and experiments are analyzed in a way to be profitable. For M. Leclerc du Sablon unity of science is a unity of method. The scientific method, par excellence, is the experimental method. Working himself in the field of biology, where deduction is less frequently used than in several other disciplines, he has failed to grasp its whole importance. The experimental character of science is emphasized to the detriment of its rational character. The author insists (wrongly we think) that all reasoning, even that of induction, can be reduced to the form of syllogism. A first demand for science is its objectivity. The principle of causality (both direct and inverse) lies at the root of all science. Phenomena are irreversible. Beginning with arithmetic and geometry, the author analyzes, from the point of view of unity, each of the several fundamental sciences of nature. He devotes one chapter to the moral sciences. He sums up his principal findings in a useful conclusion of ten pages. The book is interesting and valuable; but it does not reach the height of being an inspiring contribution to the philosophy of science.

The purpose of Henderson's "Order of Nature" is more restricted. This essay professes to demonstrate the "existence of a new order among the properties of matter" and to "examine the teleological character of this order." Modern science is said to have failed to make a systematic study of adaptability, which (it is maintained) is at bottom "a physical and chemical problem uncomplicated by the riddle of life," even though it is true that "the organism and the environment each fits and is fitted by the other." The author asks, "What are the physical and chemical origins of diversity among inorganic and organic things, and how shall the adaptability of matter and energy be described?" To this question he reaches an answer with such remarkable ease as almost to cast doubt upon its validity; nevertheless it must be admitted that he has marshaled much evidence for his conclusion.

"What is known with certainty about the history of the earth enables us to see that a few elements, and especially the four organic ones, are the chief factors. Among these nitrogen plays a somewhat subordinate rôle, especially in the mineral kingdom, while hydrogen, carbon, and oxygen, notably as constituents of water and carbon dioxide, are almost everywhere of equal importance." After discussing rather fully the characteristics of the latter three elements the author says, "We are therefore led to the hypothesis that the properties of the three elements are somehow a preparation for the evolutionary process. In truth this is the only explanation of the connection which is at present imaginable. . . . The connection between the properties of the three elements and the evolutionary process is teleological and nonmechanical."

Each of the four authors under review is evidently convinced of the truth of what one of them (Henderson) states explicitly, namely, that "men of science can no longer

shirk the responsibility of philosophical thought." The philosophy of these four, with the possible exception of Whitehead, is general and non-technical in character and is addressed primarily to those who have a trend in the direction of science. For the "general reader" the investigation of Whitehead is rather too technical and special; the work of Leclerc du Sablon is elementary and somewhat rarefied, being dispersed over too wide a range of subjects to help much in forming a scientific philosophy to live by; the work of Henderson is moved by a too narrow view, and he exhibits what Thomson in another connection speaks of as the false simplicity of materialism; but in "The System of Animate Nature" we have a magnificent contribution to the foundations of a philosophy of biology of such sort as to find a secure place in the lives of people of intelligence whether devoted to scientific pursuits or following other interests.

At the front of the two volumes of his Gifford lectures on "The System of Animate Nature" Thomson sets the following classic quotation from Francis Bacon: "This I dare affirm in knowledge of Nature, that a little natural philosophy, and the first entrance into it, doth dispose the opinion to atheism, but on the other side, much natural philosophy and wading deep into it, will bring about men's minds to religion." Thomson insists that "the scientific picture has satisfied very few thinkers of distinction, the chief reason being that the contributions which each science makes are always partial views, reached by processes of abstraction, by focusing attention on certain aspects of things." We need a more comprehensive view which allows a place for the feeling for nature and enables us to relate it to the whole of our activity.

Consequently, "the aim of this study of Animate Nature is to state the general results of biological inquiry which must be taken account of if we are to think of organic Nature as a whole and in relation to the rest of our experience. Both among careful thinkers and careless passers-by views of organic Nature are held in regard, for instance, to the organism as mechanism, the determinism of heredity, the struggle for existence. which seem to the author to be lacking in accuracy or in adequacy, which therefore tend to involve unnecessary difficulties in systematisation and perhaps gratuitous confusion in conduct. . . . While trying to keep wishes from fathering thoughts, we have been led in our study to see that the general results of Biology, when stated with accuracy, are not out of line with transcendental conclusions reached along other paths. . . . It looks as if Nature were much more conformable than is often supposed to religious interpretation, but we have not seen it to be our duty to justify the ways of God to man. We have tried to keep as close as possible to the facts of the case, leaving philosophical and religious inferences for those who are better qualified to draw them."

There is no attempt to reach transcendental results by the methods of science; but there is a persistent purpose in the lectures to show that there is nothing in science to interfere with a certain class of transcendental conclusions reached by other means. And the author does not hesitate to close his twentieth and last lecture, a remarkable one on "Vis Medicatrix Naturae" (The Healing Power of Nature), with the question: "Shall we not seek to worship Him whom Nature increasingly reveals, from whom all comes and by whom all lives?"

The first of the two volumes is devoted to the realm of organisms as it is, and the second to the evolution of the realm of organisms. The author is thoroughly convinced that the mechanistic interpretation of life is insufficient. He quotes with approval: "On the whole, there is no evidence of real progress towards a mechanistic explanation of life." He says: "The apsychic view is outrageous." "There has not yet been given any physico-chemical description of any total vital operation."

Biology seems justified in holding to the view that the evolutionary process gives rise to frequent outcrops of genuine novelties,

things not already necessarily implied in the past. "The outstanding fact about organic evolution is the increasing dominance of Mind." "Unless we have quite misunderstood evolution it implies an emergence of novelties. It is like original thinking." In it there is something like the joyous play of the organism at self expression. "It may be well for us, on our own behalf and for our children to ask whether we are making what we might of the well-springs of joy in the world; and whether we have begun to know what we ought to know regarding the Biology or the Psycho-biology of Joy."

Perhaps the most remarkable single matter in these lectures is the suggestion of a sort of cell-intelligence, particularly in the germ-cells. "Just as an intact organism from the Amoeba to the Elephant tries experiments, so the germ-cell, which is no ordinary cell, but an implicit organism, a condensed individuality, may make experiments in self-expression, which we call variations or mutations. Such, at least, is our present view of a great mystery." "The position we are suggesting is that the larger mutations, the big novelties, are expressions of the whole organism in its germ-cell phase of being, comparable to experiments in practical life, solutions of problems in intellectual life, or creations in artistic life." "The germ-cell is the blind artist whose many inventions are expressed, embodied, and exercised in the developed organism, the seeing artist who, beholding the work of the germ-cell, either pronounces it . . . to be good or . . . curses it effectively by sinking with it into extinction."

R. D. Carmichael
University of Illinois

SPECIAL ARTICLES

MORE LINKED GENES IN RABBITS

In Science for August 13, 1920, I presented evidence indicating the existence of linkage between the genes for English spotting and dilute pigmentation in rabbits. The evidence consisted of a group of 83 young produced in matings of a male heterozygous for both characters, mated with doubly recessive females. Such matings are expected to produce equal numbers of individuals of four color classes, if no linkage exists. Consistently, in his successive litters of offspring, this male sired more young in the non-cross-over classes than in the cross-over classes, which result indicated linkage of strength 23 on a scale of 100, the cross-over percentage being 38.5.

A second heterozygous male has since been tested, in similar matings with doubly recessive females, for the occurrence of linkage between the same pair of characters as seemed to be linked in the gametes of the first male, but shows *no linkage* with as much consistency as the first male showed linkage. The totals for the first male were 32 cross-over; 51 non-cross-over gametes; for the second male they are 75 : 76, as near equality as possible. The question now arises, Were the results given by the first male statistically significant? The cross-over percentage calculated as 38.5 has a probable error of 3.6 per cent. Hence the departure from 50 per cent. cross-overs (which would indicate *no* linkage) slightly exceeds three times the probable error, a result which would ordinarily be considered significant. Unfortunately no further experimental tests of this animal can now be made as he is no longer living. There can be no doubt about the negative result given by the second male. We are now confronted by this dilemma. Either the result given by the first male was *not* significant, or we may have in the same strain of rabbits two individuals, in one of which two characters show linkage, while in the other they do *not* show linkage. This latter alternative seems improbable, yet it can not be regarded as impossible on the chromosome hypothesis. Gates and Rees [1] in discussing the pollen development of *Lactuca sativa* state that the number of chromosome pairs in the species is nine but that

> Occasionally in diakinesis only eight chromosome bivalents were present, and frequently there were only seven or eight bodies present on the heterotypic spindle. This was found to be due to a tem-

[1] *Annals of Botany*, 35, 1921, p. 394.

porary end to end fusion of certain bivalents, usually the shorter ones, but occasionally the longest being involved. This phenomenon is also likely to disturb Mendelian ratios, causing partial linkage.

This last statement points out clearly the possibility of just such apparently irreconcilable results as we have obtained in the case of these two rabbits. If English spotting and dilution have their genes located in different chromosomes, the two characters will not ordinarily show linkage. If, however, these two chromosomes should form a temporary union with each other in the spermatogenesis of a male rabbit, linkage would result. Such linkage, however, would not be of the same nature as that found in *Drosophila*. Its strength would not be due to the distance apart of genes in a chromosome, but to the persistency of the temporary attachment between chromosomes ordinarily distinct.

The cytology of the rabbit is said to be difficult. Even the number of the chromosomes has not been definitely determined. According to the summary of Miss Harvey,[2] recent observers give the number as 11 or 12 pairs, but in older investigations the number is put at 14–18 pairs. One source of uncertainty as to the number may be the formation of temporary attachments between chromosomes such as Gates and Rees describe for *Lactuca*. While we await the outcome of the study of other cases, it seems reasonable to assume that the two characters, English spotting and dilution, have their genes located in distinct chromosomes, even though these may occasionally be united to such an extent as to produce partial linkage in the gametes of certain individuals.

This case shows the desirability of expressing linkage strength in terms of something less problematical than map-distances, since linkage may occur which varies quite independently of map-distance, as for example linkage between genes lying in different chromosomes. A method of expressing linkage strength on a scale of 100 has been suggested elsewhere.[3] By this method the linkage strength indicated among the gametes of the first rabbit was 23.0 ± 7.26, that for the second rabbit is 0.6 ± 2.7.

I have recently discovered in rabbits a case of linkage which is not doubtful, since it is found in the gametes of all rabbits so far studied, and in a strength which is beyond question statistically significant. This involves the same dominant character, English spotting, as was involved in the other case. It is strongly coupled with angora coat, a recessive character. The average linkage strength is over 80 on a scale of 100. Table I. summarizes the evidence for this case. In the production of the doubly heterozygous parents used in these test-matings, English and angora were derived one from the father, the other from the mother. Consequently the linkage here takes the form of "repulsion." The English young are regularly short-haired, the non-English young are regularly long-haired (angora), except in about one case in ten, when a crossover occurs.

TABLE I

Classes of Young Produced by Rabbits Doubly Heterozygous for English Spotting and Angora Coat, when Mated with Non-English Rabbits either Homozygous or Heterozygous for Angora Coat

Heterozygous English Parent	English Short	Non-English Angora	English Angora	Non-English Short	Per cent. Cross-overs
♂ 4595 (× hom. ♀♀)	25	25	2	1	5.6
" (× het. ♀♀)	18	14	3	1	11.1
♂ 4388 (× hom. ♀♀)	9	8	3	0	15.0
" (× het. ♀♀)	4	5	3	0	25.0
Het. ♀♀ (× hom. ♂♂)	16	17	0	1	2.9
Totals	72	69	11	3	9.0 ± 1.5
	Non-cross-overs		Cross-overs		

[2] *Jour. Morphol.*, 34, 1920.

[3] *Am. Nat.*, 54, May, 1920.

In order to increase the number of test matings, the males, 4,595 and 4,388, were mated with females which were merely *heterozygous* for angora coat, animals which were themselves short-haired but which had one parent an angora. Therefore only half the gametes of these females, viz., those which bore angora, would be useful in the test matings. Accordingly half the total young from such matings have been deducted before entering the totals in Table I., and of course the deductions have been made from the *short-haired* classes, equal numbers being deducted from the English and the non-English groups. Apparently male 4,595 gives a lower percentage of cross-overs than male 4,388, and the female double heterozygotes give a lower percentage than either male, but the totals are not large enough to give much weight to these ideas. The average result for all test matings is a cross-over percentage of 9.0 ± 1.5, which means linkage of strength 82 ± 3, on a scale of 100. This certainly is a significant result, which indicates that the characters English and angora have their genes in the same chromosome.

W. E. Castle

Bussey Institution,
December 1, 1921

THE HYDROGEN-ION CONCENTRATION OF CULTURES OF CONNECTIVE TISSUE FROM CHICK EMBRYOS

In view of the fact that tissue cultures in Locke-Lewis solution were to be used in observing the behavior of living cells when exposed to bacteria and other foreign substances, it became necessary to determine the optimum and the final hydrogen-ion concentration of the cultures themselves. For the purpose several hundred cultures of connective tissue of chick embryos were prepared, in Locke-Lewis solution with varying hydrogen-ion concentrations and containing different amounts of dextrose.

The normal solution was composed of 85 c.c. of Locke's solution (NaCl 0.9 per cent. plus KCl 0.042 per cent. plus $CaCl_2$ 0.025 per cent. plus $NaHCO_3$ 0.02 per cent.), together with 15 c.c. of chicken bouillon and 0.5 per cent. dextrose. This solution has a hydrogen-ion concentration between 6.6 and 7, depending upon that of each lot of bouillon. For the experiments the hydrogen-ion concentration was varied from pH 4 to pH 9.2 with an increment of 0.2, and the amount of dextrose was varied from 5 per cent. to none at all.

The hydrogen-ion concentration of the cultures explanted into these solutions was determined at different stages of their growth, namely, when they failed to grow, when they exhibited extensive and healthy growth, and when they had degenerated after vigorous growth. This determination was made by a colorimetric method devised by Felton (1921) by means of which it is possible to test the small hanging drop of a culture.

Early in the investigation it was discovered that not all kinds of coverglasses were suitable for the experiments because of the change in hydrogen-ion concentration exhibited by control drops (without explant) when incubated upon this glass. It became necessary, therefore, to select coverglasses on which the control drop remained constant when incubated for a period of three weeks.

When cultures of embryonic chick tissue were prepared on reliable coverslips, those explanted into a medium with a hydrogen-ion concentration of 4 to 5.5 seldom showed any growth; those in a medium pH 5.5 exhibited growth in a few instances; while those in media having a hydrogen-ion concentration from pH 6 to pH 9 usually showed abundant growth. Approximately one hundred cultures were explanted into solutions pH 6, 7, 8, and 9. The percentage of growth which occurred in these cultures was respectively 71, 93, 89 and 81, while that of the normal cultures (pH 6.6–7) was 90 per cent. The optimum hydrogen-ion concentration seemed to be about pH 7.

When the hydrogen-ion concentration of these cultures was tested at different stages of their growth, it was noted that while it differed markedly, this was dependent much more upon the state of the culture at the time the test was made, and also upon the amount of dextrose in the medium, than upon the initial hydrogen-ion concentration of the medium.

Regardless of what the latter had been, cultures which contained healthy and extensive growth tended to be neutral, those which failed to grow had usually become slightly acid, and those that had exhibited extensive growth and then degenerated were most frequently slightly alkaline. These results, however, apply only to solutions containing not more than 0.5 per cent. dextrose, for when 1 per cent. or more dextrose was added to the medium the cultures were often found to be acid when death took place.

In these observations the optimum hydrogen-ion concentration for tissue cultures in Locke-Lewis solution was pH 7. The final concentration depended upon the amount of dextrose in the medium. Cultures in media containing no dextrose usually had a hydrogen-ion concentration ranging from 7 to 7.6; those in media having 0.25 to 0.5 per cent. dextrose ranged between pH 6 and pH 7.8, mostly pH 7.2 and pH 7.4; while those in media to which 3 per cent. and 5 per cent. dextrose had been added were often pH 6 and pH 5.6 respectively.

M. R. LEWIS,
LLOYD D. FELTON
THE JOHNS HOPKINS MEDICAL SCHOOL

AN ELECTRICAL EFFECT OF THE AURORA

DURING the past year I have been making observations on the diurnal variation in electric potential difference between the earth, as represented by the water system of Palo Alto, and an uncharged, insulated conductor kept inside an earthed metal cage. The records of this variation have been registered continuously by a photographic method since July 20, 1920. For two weeks, or more, preceding the great aurora of May 14 these records were different from any which had preceded them, and two days before the beginning of the aurora there was a sudden change in the potential difference being measured which seemed to indicate an increase in the negative charge of the earth.

After the aurora the record of the diurnal variation was of a very different character from anything which had been obtained before. In Fig. 1, the continuous line represents the mean variation of the recorded potential-difference in millivolts for ten days preceding the aurora, and the broken line gives the same data for the ten days following the aurora. The mean daily range of the recorded potential difference on my record was 99.5 millimeters for the ten days preceding the aurora and 35.5 millimeters for the same period following the aurora.

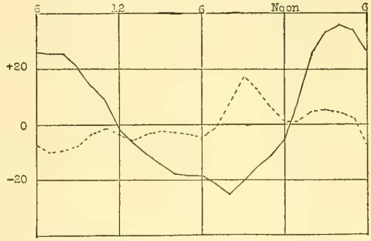

FIG. 1. Diurnal variation in potential difference between the earth and an uncharged, insulated conductor for ten days preceding and ten days following the aurora of May 14, 1921.

The mean diurnal variation in millivolts for the ten months, August, 1920, to May, 1921, is shown by the curve in Fig. 2.

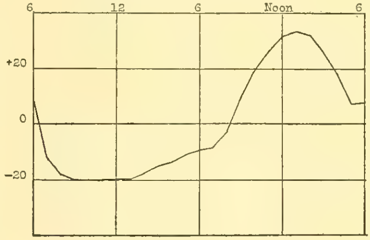

FIG. 2.

A simultaneous record of the change in the north component of the earth's magnetic field was made on the same sheet with the electrical record. For three days at the time of the aurora the magnetic record was too much disturbed to admit of measurement. The mean range of magnetic variation for

eight days preceding the aurora was 22.6 millimeters on my record; while for the five days after the record became measurable the mean diurnal variation was 17.7 millimeters.

During the entire month of June the electric records were more than usually disturbed. Early in July the disturbance increased. On July 6, 7 and 8 the disturbances were the greatest that have been observed since August 1, 1920. On the morning of July 10 an aurora was reported as visible in northern California. From that time to the present (July 19) the records have been very little disturbed and the range of variation has been much smaller than the average for the year.

FERNANDO SANFORD

THE AMERICAN CHEMICAL SOCIETY.

(*Continued*)

Increasing the yield of our dyes: J. L. BULLOCK. The first consideration is a thorough knowledge of the intermediates. Tests for quality are essential as small amounts of impurity have a decided effect on the yield. Specialization on few dyes is necessary in order to know them thoroughly. The best intermediates obtainable are usually the cheapest in that they give greatly increased yields. The sedimentation of solutions is advantageous and filtration at every stage adds to tinctorial power of the subsequent dye. In actual synthesis of dyes, intelligent use of equipment is as essential as chemical control. Uniformity in carrying out reactions is a great factor in obtaining maximum yields. Diazotizations should be as rapid as possible. Coupling a difficult condensation; the foam a good indication of its course. It is important to precipitate the dye in an easily filterable state. With triphenylmethane dyes even greater care must be used than with the azo dyes. A knowledge of the dyeing properties, fastness, etc., is very useful in getting the standard of purity to the highest possible point. Attention to the most minute details is repaid by increased tinctorial power and lessened cost of the finished dye.

The preparation in the pure state of certain dyes of the malachite green series: WALTER A. JACOBS AND MICHAEL HEIDELBERGER. It is shown that in many cases in which the chlorides are too soluble or do not crystallize, the nitrates may advantageously be used for isolation of the dyes. Descriptions are given on this basis of salts of malachite green and some of its methyl, halogen, amino, acylamino, alkylamino, hydroxy, and alkoxy derivatives, as well as the nitrate of brilliant green, and the furfurol analog of malachite green.

The electrometric titration of azo dyes: D. O. JONES. The titanous chloride reduction methods originally suggested by Knecht for the analysis of numerous compounds, both organic and inorganic, have, in recent years, come into more general use in the field of dye chemistry. The titanous chloride method for the analysis of azo dyes becomes more generally applicable, when the end point of the titration is determined by the electrometric method. The method in general is similar to the usual oxidimetric analysis as carried out with the electrometric apparatus. In the former methods, employing the use of a sulphocyanide indicator, the end point in the back titration with ferric alum is sometimes difficult to determine. Dark colored material in suspension and the color which is sometimes imparted to the solution by the products of reduction do not interfere in the electrometric method. It also permits the use of larger samples, while the end point is readily and accurately obtained.

Extraction process of wool degreasing: LOUIS A. OLNEY. A thorough study of the subject of wool cleansing is quite sure to lead to the conclusion that the extraction method, *i.e.*, the treatment of the raw wool under proper conditions with certain organic solvents, is far more scientific in principle than the ordinary emulsive process. With efficient apparatus and good management the expense of cleansing wool is reduced to a minimum by this process and the results obtained approach the maximum established through theoretical and economical considerations. Although the early attempts to degrease wool by the use of volatile solvents resulted in complete failure, many practical incentives sufficed to keep interest in the process alive.

Fastness to storage: OSCAR R. FLYNN. Dyed cotton goods sometimes changes unevenly when stored in the folded piece. Regions of change mark out the channels along which air flows due to changes in temperature. This shows that the change in the dye is caused by some substance present in the air in small quantity and not primarily to oxidation, which shows its effect in the interior of a mass of goods. In some cases the change is temporary, and the result of the action of acid alone. In other cases the effect is due in the first place to acid, but followed later by complete destruction of the dye. Alkali sensitive dyes such as Stilbene Yellow show temporary changes due to acid alone. Acid sensitive dyes, such as

Congo Red, show permanent change due to fading after actions of acid. When alkalis are used in finishing, enough should be used to last a year or more. Alkali sensitive dyes should be finished in the acid condition. Dyes fast to acid and alkali are safest.

Relation of chemical structure to dyeing properties: WARREN N. WATSON.

Special cost features and their relation to the development of our organic chemical industry: GASTON DUBOIS.

The effect of dye structure on dye adsorption: LEON W. PARSONS AND W. A. MCKIM. Some preliminary results which were obtained during the course of an extended investigation now being conducted on the relation between the structure of dyes and their adsorption constants are discussed. Data have been obtained regarding the constants of adsorption in the case of the following water-soluble dyes when equilibrated with wool at constant temperature—picric acid, eosin, erythrosine, brilliant green, malachite green, ponceau 2G, ponceau 4GB, chromotrope 2R, and chromotrope 2B. In all cases, the equilibrium points obtained are found to be well represented by the Freundlich adsorption equation. A close similarity in structure between dyes within a certain chromophoric classification gives practically the same value for 1/n, one of the Freundlich constants, whereas a wider difference in structure is accompanied by a corresponding tendency toward divergence in the value of 1/n. Some interesting results have been obtained regarding the effect on adsorption of loading the pure dyes with various amounts of sodium sulfate.

Is an export trade necessary to the dye industry?: J. MERRITT MATTHEWS.

Preparation of amino-phenol-sulfonic acid by the chloro-benzene method: JOSEPH R. MINEVITCH. Amino-phenol-sulfonic acid (2: 1: 4) is best prepared by reducing the corresponding nitro-phenol-sulfonic acid with either acid or alkali reducing agents, depending upon the medium in which the nitro body is last obtained. A successful manufacturing process would, therefore, largely be based upon the ease with and small cost at which the nitro compound can be produced in large quantities. There are four other possible methods for its manufacture but the chloro-benzene process gives the highest yield and at a vastly cheaper cost. The paper will consist of a discussion of experimental results and will give directions for preparation.

The future of research in the dye industry: M. L. CROSSLEY. Research is of vital importance to the dye industry. Men must be carefully selected and thoroughly trained. It is of the utmost importance that only those giving promise of research ability and possessing the capacity for the development of the spirit of research should be selected. To depend upon "the law of the survival of the fittest" to eliminate the unfit is economically wasteful and dangerous. A grave responsibility rests upon our educational institutions for the selection and training of men to direct and carry on the future activities of our industries. The training for research must be thorough. Herein, our system of education is weak. There must be greater appreciation of the contribution of research to the progress of industry before research will be correctly evaluated. The compensation of the research man must be commensurate with his service to the industry, if the best men are to be encouraged to serve in this field. The future of the dye industry in this country will depend upon our ability to develop able research men and upon our willingness to adequately appreciate the contribution of research to the progress of the industry.

The qualitative and quantitative evaluation of dyestuffs: ROBERT E. ROSE. Determining the value of dyestuffs is an art as complex as that of the gem expert. The dye tester must compare different colors so closely that he is able to tell the difference produced by 1/32 of an ounce of color in 1000 lbs. of material. He must do this on a little sample, weighing 1/14 to 1/3 oz., that is, he actually sees the difference produced by adding or subtracting 1/10,000,000 of an ounce of the dyestuffs in the field of vision. In the matter of shade he must check one lot of dye against another and not pass any two that vary perceptibly to the ordinary eye. If he is asked to do so, he must be ready to match colors just as exactly.

A method for the use of metal sensitive chrome colors in iron machines: FRANCIS C. TELEN.

The present status of the domestic coal-tar product industry: C. R. DE LONG.

DIVISION OF WATER, SEWAGE AND SANITATION

W. P. Mason, Chairman

W. W. Skinner, Secretary

Investigations of the chemical reactions in water purification, using the hydrogen electrode: A. M. BUSWELL. Titration curves with carbonates of sodium, magnesium and calcium, using a strong acid, show that the shape and position of the curve is

unaffected by the metal ion, but that the inflection point occurs at a slightly lower hydrogen-ion concentration in dilute solutions than in the more concentrated ones. Precipitation curves of the precipitation of calcium as the carbonate while not as regular as those obtained in the precipitation of magnesium, tend to show that the reaction is complete, sufficient carbonate being present, at a hydrogen-ion concentration corresponding to pH of 9.5.

Study of the Weszelszky method for the determination of iodide and bromide: W. E. Shaefer and J. W. Sale. The Weszelszky method has been carefully tested. The kind and quantity of absorbing alkali and the time and temperature used to remove the chlorate were varied until satisfactory conditions for the recovery of bromine from bromine water were found. A modified absorption apparatus was constructed and the kind and concentration of the acid added to the reaction flask varied in an effort to recover bromine quantitatively from potassium bromide and estimate it by the method found to be satisfactory. Iodine was converted into iodic acid by chlorine water in the reaction flask and estimated in solutions of various acid concentrations. A rapid and satisfactory modified Weszelszky method for the determination of small amounts of iodine based on these experiments is given. The Weszelszky method for bromide in the presence of iodide, however modified, is incapable of giving satisfactory results on small samples and its use is not recommended.

Purity of bottled mineral waters: W. W. Skinner and J. W. Sale. During the past year, the Water and Beverage Laboratory of the Bureau of Chemistry has made sanitary inspections of about seventy-five springs and wells, located in ten states. These inspectors uncovered numerous unsuspected sources of pollution of which specific examples are described. Samples of water from interstate shipments and from shipments offered for entry into the U. S. are also analyzed for their purity. In the last six years over 4,000 bottles were opened and the water examined. Shipments of polluted water are either refused entry in the case of foreign waters or are condensed and destroyed in the case of domestic waters.

Commercial peptones and the culture media used in the examination of water: E. M. Chamot and F. R. Georgia. Titration curves of the following peptones are shown: Witte; Bacto (Digestive Ferments Company); Proteose (Digestive Ferments Company); Armour's; Parke, Davis Company; Fairchild Brothers and Foster; and Stearns. The peptones are grouped according to relations shown by these curves. The optimum reaction (P_H) using a culture of *B. coli* is given for each peptone. This is determined by attenuating the culture by exposure to a suitable dilution of phenol and inoculating a series of tubes containing the peptone solution adjusted to various P_H values at definite time intervals and noting the P_H value in which growth is obtained after exposure of the culture to the phenol for the longest period of time. It is shown that Witte, Bacto, Proteose, Armour's, and Parke, Davis and Company Peptones give optimum growth when unadjusted or but very slightly adjusted. With Fairchild Brothers and Foster's and Stearns's peptones it is necessary to adjust the reaction to a P_H value slightly above 5.7. It is shown that the optimum P_H value for *B. coli* in peptone KCl solution varies over a considerable range and depends on the peptone used. The introduction of lactose into the medium changes the optimum P_H value.

A study of the activated sludge process: J. A. Wilson, W. R. Copeland and H. M. Heisig.

Mineral composition of the water supply of seventy cities in the United States: J. W. Sale and W. W. Skinner. The paper develops the fact that statistics showing the mineral composition of the water supplies of even the larger cities in the United States have not been compiled heretofore, although the matter is of considerable interest particularly to physicians and to the traveling public. Seventy analyses obtained from city officials have been reduced to a common basis for comparison and tabulated. Of the cities mentioned, Atlanta, Ga., has a water supply which contains the smallest amount of dissolved mineral matter, while Oklahoma City, Okla., has a water supply which contains the largest amount of dissolved mineral matter.

Quantitative versus qualitative adjustment of the H-ion concentration of culture media: Geo. C. Bunker and Henry Schuber. The reactions of culture media prepared in the laboratories of waterworks are determined by one of the following three methods, of which the first two may be classed as loose and the third as approximate in reference to their precision. (1) By titration with phenolphthalein, (2) with phenol red or with brom thymol blue and (3) by comparison of a portion of the medium, to which a suitable indicator has been added, with color standards of definite H-ion concentration. The methods are discussed.

Charles L. Parsons,
Secretary

SCIENCE

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SCIENCE

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(a) ON SOME PRESIDENTIAL ADDRESSES: (b) THE WAR AGAINST THE INSECTS[1]

To prepare a presidential address to be delivered before either the British or the American Association for the Advancement of Science is a very serious matter, and many eminent men have found it so. Is it not a sad thought that each year for many years there has been a man here and one over there who has had to worry for months, first as to his subject and again as to its mode of presentation? Of course, it sometimes happens that a man like Mr. Balfour over there or Dr. Eliot on this side is made president, and of course such men can write profound and charming addresses almost in their sleep, they have become so accustomed to formal functions of great importance. But the average man of science, even of presidential caliber, is a specialist, absorbed in his work, and the sudden realization that he must prepare an address which should interest all scientific men and should help to interest others in science is appalling.

I imagine that few of you have ever thought of this psychological aspect of presidential addresses. Possibly many of you never took the trouble to read a presidential address. Presidential addresses are things one is rather inclined to take for granted, and when one turns the pages of the journal *Nature* or the journal *Science* one is apt to say to oneself "That looks good; some day I must read it"; and then, after a glance at the news notes, the journal goes on file. In other words, presidential addresses demand the serious attention of the men who prepare them and of very few besides. Yet, I have never heard a presidential address before either the British Association or

[1] Address of the President of the American Association for the Advancement of Science, Toronto, 1921.

the American Association that did not deserve serious reading and study.

For twenty-three years, year after year, I have sat on the platform near the president of the American Association for the Advancement of Science during the delivery of his address, until I may justly claim to be an expert on presidential addresses, in much the same way that the leader of a hotel-orchestra can claim to be an expert on after-dinner speeches—because he has heard so many!

At all events, the twenty-two and more addresses of this character which I have heard, and the one hundred others which I have read, have given me the idea that it would not be amiss to deliver a presidential address on the subject of presidential addresses. I have been rather pleased with this idea, and will in fact elaborate it before I take my seat.

But there are other ideas that have been almost equally insistent and which fit rather more closely to the average notion of propriety for so important an address as this theoretically should be. One of them is a consideration of what seem to me to be educational fallacies in the teaching of science to-day, and especially of the biological sciences. But I am modest, and I am ignorant. I have never been a teacher, and, in order to discuss this vital question in any but a perfectly one-sided way, one must know intimately the viewpoint and the ultimate aim of those who control the teaching, especially of the biological sciences, in our great laboratories. I should visit the work shops at Harvard and Yale, at Columbia, at the University of Pennsylvania, at Johns Hopkins, at the University of Chicago, or here, at Toronto, and talk at length with the men in charge; and then I should go to Woods Hole in the summer, where the teachers themselves go to study and to be taught, and should do my utmost to convince myself that they are right in ignoring most practical problems and are justified in spending their lives on the search for fundamental principles and, what is more to the point, teaching little but facts and methods relating to their own studies and to the studies of their school. I have no time for this, and so can not enter fairly into the subject.

As I am writing this (July 29), I see that Sir Edward Thorpe has announced as the subject of his address before the British Association at Edinburgh "The Aspects and Problems of Post-War Science, Pure and Applied." It was the war that helped make me more dissatisfied than ever with the results of biological teaching in America, just as it has been the war that has caused the British people to distrust their whole educational system. With us in Washington, the teachers from the principal universities were brought together, and a National Research Council was formed. The results of the work of this organization in the direction of biology and agriculture, so far as they applied to the prosecution of the war, were largely negative; but that much good will result to the country by the bringing of these men to Washington in the great emergency there can be little doubt, since I have the hope that it opened their eyes to the fact that their university work might have been of much greater value to their country, and to the further fact perhaps that there exist under the federal government agencies which are working upon biological problems effectively and with the highest attention to scientific methods and scientific ideas.

Laying aside then this idea of an educational discussion, the idea that is always with me, of once more considering what Sir Harry Johnston has with his usual felicity called "the next great world war"—the war of humanity against the class *Insecta*—has still further impressed itself upon me. And so there are two topics which I shall briefly discuss—first, presidential addresses, and, second, our struggle against insects.

ON SOME PRESIDENTIAL ADDRESSES

Let us hurriedly glance at the presidential addresses delivered before the British and the American Associations from 1895 down to last year, 1920, and at the men who delivered them. During that period there were 27 such addresses before the American Association and 24 before the British Association, the discrepancy being due to the omission of the 1917 meeting of the

British Association and the holding of two extra meetings by the American Association.

It was formerly the custom in the British Association to review the progress of science each year, and this was usually done in a way in the address of the president. As time went on and science became very intricate and highly specialized in its different parts, the individual, no matter how great his ability and his general knowledge, found himself less and less able to cover the whole field, and so the character of the presidential addresses became diversified. In a measure the same trend has occurred in America. But the British, more conservative than we are over here, or perhaps having the habit of electing broader men to the presidency, have been slower in breaking away from custom, and of their later addresses on the other side seven of the twenty-four have been devoted to a review of the progress of science, while in America only two out of twenty-seven have followed this old and admirable plan. But the diversity in the other addresses has been almost as great with the British as with the Americans. On topics connected with physics, there have been 3 with the British and 3 with the Americans; with anthropology, 2 with the British and 2 with the Americans; in astronomy, 1 with the British and 3 with the Americans; botany, 1 British and 2 American; medical science, 2 British and 2 American; geology, 1 British and 2 American; chemistry, 1 British and 2 American; biology, 2 British and 3 American; economics, 2 American; engineering, 1 British; and the remaining addresses can not be classified.

What a wealth of good things can be found in these addresses! Who can forget Sir Joseph Lister's address on "The Interdependence of Science and the Healing Art" delivered at Liverpool, 1896, and the modest way (characteristic of the man) in which he broke his long silence concerning his own great part in the discoveries that revolutionized the surgical practise of the world? He said,

> Pasteur's labors on fermentation have had a very important influence upon surgery. I have been often asked to speak on my share in this matter before a public audience, but I have hitherto refused to do so, partly because the details are so entirely technical, but chiefly because I have felt an invincible repugnance to what might seem to savor of self-advertisement. The latter objection now no longer exists, since advancing years have indicated that it is right for me to leave to younger men the practise of my dearly loved profession. And it will perhaps be expected that, if I can make myself intelligible, I should say something upon the subject on the present occasion.

Who of us Americans who heard it can forget the address of Sir John Evans at the Toronto meeting in 1897, in which the following words were used,

> Our gathering this year presents a feature of entire novelty and extreme interest, inasmuch as the sister Association of the United States of America —still mourning the loss of her illustrious President, Professor Cope—and some other learned societies, have made special arrangements to allow of their members coming here to join us. I need hardly say how welcome their presence is, nor how gladly we look forward to their taking part in our discussions, and aiding us by interchange of thought. To such a meeting the term "international" seems almost misapplied. It may rather be described as a family gathering, in which our relatives more or less distant in blood, but still intimately connected with us by language, literature, and habits of thought, have spontaneously arranged to take part.
>
> The domain of science is no doubt one in which the various nations of the civilized world meet upon equal terms, and for which no other passport is required than some evidence of having striven towards the advancement of natural knowledge. Here, on the frontier between the two great English-speaking nations of the world, who is there that does not inwardly feel that anything which conduces to an intimacy between the representatives of two countries, both of them actively engaged in the pursuit of science, may also, through such an intimacy, react on the affairs of daily life, and aid in preserving those cordial relations that have now for so many years existed between the great American Republic and the British Islands, with which her early foundations are indissolubly connected?

How well the following years have carried forward this idea of Sir John Evans, not only in the domain of science but in the vital affairs of national relations, was amply shown in England's influential moral support of the United

States in the war with Spain, and the response of millions of the American youth to the call from the other side during the terrible years so recently passed, thousands upon thousands of them not waiting for the direct call of their seemingly slow government.

In thinking of those days I love to remember the eloquent words of an Oxford contributor to the *London Times* of April 13, 1917, just before the cream of our youth in rapidly increasing numbers had gone over, thousands to serve with your Canadian troops, and thousands more to help the cause of right in other service.

> It is difficult to judge a whole nation. What is the criterion of judgment, and who are they that are judged? Some of us, and some of our own citizens, have judged America and found her wanting in open-eyed recognition of the issues of this struggle and unflinching determination to face the issues boldly. But if we are to be judged by our statesmen, might we not too deserve the same judgment? The issues were coming, coming, coming for years before this war began. Yet it is not easy to say that our recognition of these issues was open-eyed, and our determination to meet them unflinching. We do not dwell on these things in our past, and why should we dwell on these things and things like these in the history of another nation? If a nation is to be judged, let it be judged by the answer that its spirit makes, in the hour of need, through its purest and most chosen voices—the voice of the young, who are the first to hear and the quickest to obey, the call of Duty and Honor. If that be our criterion, and these are they that are judged, then America may be proud, and may stand secure in the day of judgment. For her young men answered, and answered early, and their answer was "We come."

While there have been two addresses relating to the great war, the one by Sir James Thorpe delivered at Edinburgh last summer, and that read by Van Hise at the Pittsburgh meeting of 1917 entitled "Some Economic Aspects of the World War," the subject of human warfare does not seem to have been mentioned in any of the presidential addresses of earlier years, with one exception: Asaph Hall, the astronomer, in his Washington address in 1903, the title of which was "The Science of Astronomy; Historical Sketch, its Future Development, the Influences of the Sciences on Civilization," used the following words which to-day are of extraordinary significance in view of recent events:

> Men do not change much from generation to generation. Nations that have spent centuries in robbery and pillage retain their disposition and make it necessary for other nations to stand armed. No one knows when a specious plea for extending the area of civilization may be put forth, or when some fanatic may see the hand of God beckoning him to seize a country. The progress of science and invention will render it more difficult for such people to execute their designs. A century hence it may be impossible for brutal power, however rich and great, to destroy a resolute people. It is in this direction that we may look for international harmony and peace, simply because science will make war too dangerous and too costly.

Quite as striking as this, but in another way, was Sir Norman Lockyer's address at Southport in 1903, in which he discussed "The Influence of Brain Power on History." This was mainly a plea for more universities and more research and the need of a scientific national council. Had this strong plea been heeded and acted upon, England would have found herself in much better condition to confront Germany in 1914.

In general these addresses have been extremely serious. Nearly all of the men delivering them have felt that they had an important message to give. All have felt the importance of the occasion and have tried to rise to it. As a result, traces of true humor have been scarce, and it is with a surprised joy that one greets the following paragraph in Farlow's address at New Orleans in 1906. His subject was "The Popular Conception of the Scientific Man at the Present Day," and his address was largely devoted to a discussion of government and university scientific positions. In his introduction he said:

> We are so accustomed to hear reports on the progress of science that we have almost ceased to ask ourselves what we mean by progress. What is or is not progress depends of course upon the point of view. Some are so far ahead of the majority that they can not see how much progress is made by those behind them, others are so far in the rear

that they can not distinguish what is going on ahead of them. We must also admit that there are different directions in which progress may be made. You have all seen the agile crab and been surprised to find how rapidly he gets over the ground, although he never seems to go ahead, but to scramble off sideways. The crab, perhaps, wonders why men are so stupid as to try to move straight forward. It is a popular belief, but, not being a zoologist, I am not prepared to vouch for its correctness, that the squid progresses backward, discharging a large amount of ink. One might perhaps ask: Is the progress of science sometimes like that of the crab, rapid but not straight forward, or, like the squid, may not the emission of a large amount of printer's ink really conceal a backward movement? So far as the accumulation of facts is concerned, there is a steady onward progress in science and it is only in the unwise or premature theorizing on known or supposed facts that science strikes a side track or even progresses backward.

A few Americans were present at the Australasian meeting of the British Association in 1914 and had the pleasure of listening to the remarkable addresses on heredity delivered at Melbourne and Sydney by the distinguished guest of the American Association at this present meeting, Prof. William Bateson. These lectures, for general and vital interest, are almost unsurpassed in the long list of presidential addresses delivered before the one or the other of the two great associations. Only a few of us heard them; many of us have read them; and it is a joy to know that we are to listen to Professor Bateson to-morrow night.

Several of the retiring presidents in both associations have ventured into the domain of prophecy. Even now the address of Sir William Crookes at Bristol in 1898 is remembered. His startling display and discussion of the decreasing wheat supply of the world and the necessity of securing nitrogen from the air created an enormous amount of interest. Ten years later, Nichols at Baltimore, in his discussion of "Science and the Practical Problems of the Future," referring to the exhaustion of our supply of fixed nitrogen, the contingency discussed by Sir William Crookes in 1898, and to the exhaustion of our free oxygen more recently discussed by Lord Kelvin, concluded that these problems were still so remote as to have no immediate practical importance; but his address was written at a time when the conservation movement was just beginning in this country although it had already gained much force, and he referred especially to the coming exhaustion of coal, wood, ores and soils. His address was a tremendous plea for intensive research, and included the significant sentence, "We need not merely research in the universities, but universities for research." One of his final sentences reads, "Beyond lies that future in which it will no longer be a question of supremacy among nations, but of whether the race is to maintain its foothold on the earth."

The very following year, Chamberlin at Boston, in making "A Geologic Forecast of the Future of our Race," concluded with a more hopeful outlook and sent his audience home in a much happier frame of mind. He said:

> While, therefore, there is to be, with little doubt, an end to the earth as a planet, and while perhaps previous to this end, conditions inhospitable to life may be reached, the forecast of these contingencies places the event in the indeterminate future. The geologic analogies give fair ground for anticipating conditions congenial to life for millions and tens of millions of years to come, not to urge even larger possibilities.

But these fifty-one addresses, as well as those that preceded them, are full of significant and quotable things. We on this side will never forget that remarkably beautiful address of Jordan's in 1910 on "The Making of a Darwin." Those on the other side who heard it will never forget Professor Schaefer's address at Dundee in 1912, on the "Nature, Origin and Maintenance of Life," in which, in closing, he gives a wonderfully eloquent description of natural death—"A simple physiological process as natural as the on-coming of sleep."

This leads us to the side thought, not only of Professor Schaefer's own age at that time (it was sixty-two), but also to the interest attaching to the ages of all of the presidents

of the two associations. It is undoubtedly true that each of these men had achieved unusual prominence in scientific work at the time he became president of the one or the other of the two great associations. An analysis of the careers of each one of them is not possible at the present time, nor is it possible to indicate whether his address was delivered at the crowning period of his productive scientific life. With some of them it was, with others it was not. As a matter of fact, however, the average age of the presidents of the British Association was sixty-one years and eleven months, and with the American Association it was sixty-one years and five months. The youngest president of the British Association during the period under consideration was fifty-three years of age. This held for Professor Rucker, Sir J. J. Thomson, and Professor Bateson. The oldest of them was Professor Bonney, whose address was delivered at the age of seventy-seven. The youngest of the American presidents were Minot and Richards, whose addresses were delivered at the age of fifty; and the oldest was Eliot, whose Philadelphia address was delivered when he was seventy-nine years old. I remember that Dr. Eliot hesitated to accept the presidency on the ground that he might not live another year to deliver his address. That was eight years ago and he is still living and writing at the age of eighty-seven.

One is strongly tempted at this point to enter briefly upon a discussion as to the average length of the productive life of a scientific man and as to the average period of its practical end. But the semi-humorous and totally misunderstood remark by Sir William Osler at his farewell address at Johns Hopkins in 1904 has been so voluminously criticized and has caused so much sorrow, or so much indignation as the case may be, to still productive men away past their early forties, and the side of the veterans has been so triumphantly defended, that further argument and illustration are unnecessary. We may safely assume, in fact, that the usefulness of the man past middle age is granted, and that, while he may not have the illuminative bursts of inventive or speculative genius which come to the younger man, he is better able to make the broad generalizations based upon accumulated experience—in other words, to prepare an appropriate presidential address as president of the British or the American Association for the Advancement of Science!

But so far I have only skirted a promising field. I have an idea that some one should go deeply into the subject, not only of presidential addresses before the British and American Associations, but of all presidential addresses. Why do we have such addresses? If there is a good reason—and there probably is—why do not people read them? Or *does* some one read them? And if so, who? and why? Some presidents prepare addresses which they hope will interest the people who come to listen to them. Others are perfectly indifferent to their listeners, and perfunctorily read addresses intended for later severely restricted groups of readers, such as the professional astronomers of the world, as Harkness did, for example, in 1893 at Madison. A host of ideas occur to me that suggest promising lines of investigation, but I leave their elaboration to some one of my successors who may like the task and who may be a psychologist fitted by training to deal with it.

THE WAR AGAINST THE INSECTS

Count Korzybski, in his recent remarkable book "The Manhood of Humanity," gives a new definition of man, departing from the purely biological concept on the one hand and from the mythological-biological-philosophical idea on the other, and concludes that humanity is set apart from other things that exist on this globe by its *time-binding* faculty, or power or capacity. This is another way of saying that man preserves the history of the race and should be able to profit by a knowledge of the past in order to improve the future. It is indeed this *time-binding* capacity which is the principal asset of humanity, and this alone would make the

human species the dominant type of the vertebrate series. But, biologically speaking, there is another class of animals which, without developing the *time-binding* faculty, has carried the evolution of instinct to an extreme and has in its turn come to be the dominant type of another great series, the Articulates, or the Arthropods. As Bouvier puts it,

> Man occupies the highest point in the vertebrate scale, for he breaks the chain of instincts and assures the complete expansion of his intelligence. The insects hold the same dominating position in the Articulates where they are the crowning point of instinctive life.

Unlike the Echinoderms and the Mollusks which have retained their hard coverings or shells and have therefore progressed more slowly—for, as Bergson says, "The animal which is shut up in a citadel or a coat of mail is condemned to an existence of half sleep"—vertebrates, culminating in man, have acquired the bodily structure which, with man guided by the equally acquired intelligence, has enabled him to accomplish the marvels which we see in our daily existence. And, too, the Articulates have in the course of the ages been modified and perfected in their structure and in their biology until their many appendages have become perfect tools adapted in the most complete way to the needs of the species; until their power of existing and of multiplying enormously under the most extraordinary variety of conditions, of subsisting successfully upon an extraordinary variety of food, has become so perfected and their instincts have become so developed that the culminating type, the insects, has become the most powerful rival of the culminating vertebrate type, man.

Now, this is not recognized to the full by people in general—it is not realized by the biologists themselves. We appreciate the fact that agriculture suffers enormously, since insects need our farm products and compel us to share with them. We are just beginning to appreciate that directly and indirectly insects cause a tremendous loss of human life through the diseases that they carry. But apart from these two generalizations we do not realize that insects are working against us in a host of ways, sometimes obviously, more often in unseen ways, and that an enormous fight is on our hands.

It will be obvious, I think, that this statement is not overdrawn. Quite recently a better appreciation of the situation is beginning to show itself. Early in the war (July, 1915) Sir Harry Johnston's strong article entitled "The Next War: Man *versus* Insects" was published in *The Nineteenth Century*; and at the close of the war precisely the same title was used by Lieutenant Colonel W. Glen Liston, of the Indian Medical Service, in his address as president of the Medical Research Section of the Indian Science Congress held at Calcutta in January, 1919. On this side, articles by Felt of Albany, Brues of Harvard, and by the present speaker called especial attention to the important part that entomology and entomologists played during the world war, and since that time several energetic newspaper writers have been trying to place the case before the public.

It is difficult to understand the long-time comparative indifference of the human species to the insect danger. A little more than a hundred years ago the popular opinion of entomology and entomologists in England was well expressed by that admirable character, the Rev. William Kirby, in the following words:

> One principal cause of the little attention paid to entomology in this country has doubtless been the ridicule so often thrown upon the science. The botanist, sheltered now by the sanction of fashion, as formerly by the prescriptive union of his study with medicine, may dedicate his hours to mosses and lichens without reproach; but in the minds of most men, the learned as well as the vulgar, the idea of the trifling nature of his pursuit is so strongly associated with that of the diminutive size of its objects, that an *entomologist* is synonymous with everything futile and childish. Now, when so many other roads to fame and distinction are open; when a man has merely to avow himself a botanist, a mineralogist, or a chemist—a student of classical literature or political economy—to ensure attention

and respect, there are evidently no great attractions to lead him to a science which in nine companies out of ten with which he may associate promises to signalize him only as an object of pity or contempt. Even if he had no other aim than self-gratification, yet " the sternest stoic of us all wishes at least for some one to enter into his views and feelings, and confirm him in the opinion which he entertains of himself "; but how can he look for sympathy in a pursuit unknown to the world, except as indicative of littleness of mind?

This popular impression, so well described by Kirby, continued, and jokes, anecdotes, cartoons, novels and dramas perpetuated the old idea. But even during the active lifetime of the speaker there has come a change. Good men, men of sound laboratory training, have found themselves able in increasing numbers, through college and government support, to devote themselves to the study of insect life with the main end in view to control those forms inimical to humanity, and to-day the man in the street realizes neither the number of trained men and institutions engaged in this work nor the breadth and importance of their results not only in the practical affairs of life but in the broad field of biological research. The governments of the different countries are supporting this work in a manner that would have been considered incredible even five and twenty years ago, and this is especially true of the United States and Canada and hardly less so of France and Italy and Japan and South Africa and, at least until four years ago, Russia.

It may be worth while here, however, to point out that certain European countries are combining their studies of agricultural entomology and crop diseases under the term phytopathological studies, or an Epiphyte Service (*Service des Epiphyties*), as in France, and this is unfortunate, since it obscures to a certain extent the great issue of insect warfare and divides the great field of economic entomology in a most unfortunate way. Let us hope that the movement will not grow. Let the entomologists cooperate with the pathologists, both plant and animal, wherever there is something to be gained by such cooperation, but let us keep the respective fields entirely clear.

The war against insects has in fact become a world-wide movement which is rapidly making an impression in many ways. Take the United States, for example, where investigations in this field are for the time being receiving the largest government support. Every state has its corps of expert workers and investigators. The federal government employs a force of four hundred trained men and equips and supports more than eighty field laboratories scattered over the whole country at especially advantageous centers for especial investigations. And there are teachers in the colleges and universities, especially the colleges of agriculture, who are training clever men and clever women in insect biology and morphology and in applied entomology both agricultural and medical.

All this means that we are beginning to realize that insects are our most important rivals in nature and that we are beginning to develop our defense.

While it is true that we are *beginning* this development, it is equally true that we are only at the start. Looking at it in a broad way, we must go deeply into insect physiology and minute anatomy; we must study and secure a most perfect knowledge of all of the infinite varieties of individual development from the germ cell to the adult form; we must study all of the aspects of insect behavior and their responses to all sorts of stimuli—their tropisms of all kinds; we must study the tremendous complex of natural control, involving as it does a consideration of meteorology, climatology, botany, plant physiology, and all the operations of animal and vegetal parasitism as they affect the insecta. We must go down to great big fundamentals.

All this will involve the labors of an army of patient investigators and will occupy very many years—possibly all time to come. But the problem in many of its manifestations is a pressing and immediate one. That is why we are using a chemical means of warfare, by spraying our crops with chemical compounds and fumigating our citrus orchards and mills and warehouses with other chemical compounds, and are developing mechanical means both for utilizing these chemical means and for

independent action. There is much room for investigation here. We have only a few simple and effective insecticides. Among the inorganic compounds, we have the arsenates, the lime and sulphur sprays, and recently the fluorides have been coming in. Of the organic substances, we use such plant material as the poisons of hellebore and larkspur, pyrethrum and nicotine; and the cyanides and the petroleum emulsions are also very extensively used. No really synthetic organic substances have come into use. Here is a great field for future work. Some of the after happenings of the war have been the use of the army flame-throwers against the swarms of locusts in the south of France, the experimental use against insects of certain of the war gases, and the use of the aeroplane in reconnoissance in the course of the pink bollworm work along the Rio Grande, in the location of beetle-damaged timber in the forests of the Northwest, and even in the insecticidal dusting of dense tree growth in Ohio. The chemists and the entomologists, working cooperatively, have many valuable discoveries yet to make, and they will surely come.

All this sort of work goes for immediate relief. Our studies of natural control follow next. It is fortunately true that there are thousands upon thousands of species of insects which live at the expense of those that are inimical to man and which destroy them in vast numbers; in fact, as a distinguished physicist in discussing this topic with me recently said, "If they would quit fighting among themselves, they would overwhelm the whole vertebrate series." This is in fact one of the most important elements in natural control and is being studied in its many phases by a small but earnest group of workers.

So far, while we have done some striking things in our efforts at biological control, by importing from one country into another the natural enemies of an injurious species which had itself been accidentally introduced, and while we have in some cases secured relief by variations in farm practise or in farm management based upon an intimate knowledge of the biology of certain crop pests, we are only touching the border of the possibilities of natural control.

For an understanding of these possibilities, we must await the prosecution of long studies, just as we must await years of progress of those other studies outlined in a previous paragraph. And all of these studies must be carried on by skilled biologists—thousands of them. At present most of the best men are working away in their laboratories practically heedless of the great and inviting lines of study at which I have hinted and heedless of the tremendous necessity for the most intense work by the very best minds on the problem of overcoming and controlling our strongest rivals on this planet.

And this brings me back to the topic which I touched upon in my opening remarks, namely, the teaching of biology in our colleges and universities. You will remember that I thought to avoid a discussion of this subject because I felt that I could not do it justice without more careful investigation and without a clear knowledge of the viewpoints and purposes of the educators. A good many of us have been thinking for a long time that the teaching of zoology and botany and the so-called biology in the principal colleges and universities in the United States and Canada, and in Europe as well, has taken the wrong trend, or that, if not taking the wrong trend, very many of the more important aspects of these subjects are being ignored, and that everything was running in a single direction. I said a good many of us. That means that, when we come to count them up, there really have been a good many, but they have been so greatly in the minority that they have been ignored in the general movement. Here and there a man has spoken out, but all too infrequently. Jordan, in his presidential address before the American Association, was one of these. C. C. Nutting, in two or three papers, has in a forceful and somewhat humorous way pointed out some of the inconsistencies of modern biological training. Edwin Linton, in his strong and fine address at the Baird Memorial meeting in Washing-

ton in 1916, put it forcibly in the following words:

> As I look over the titles of theses for doctorate degrees in biology, however, knowing that they must, in some fashion, reflect the activities of our biological leaders, I am led to wonder if the failure of science to influence legislation in the interests of the people is not to be charged to the propensity on the part of these leaders to shun the practical. Is there a hierarchy in science that frowns upon independence of thought and action in her sanctuary? That can hardly be. Let the heads of departments of biological research in our universities then take heart, and not be afraid to follow the lead of Pasteur, who surely committed no violence upon science by undertaking the solution of practical problems.

In very recent years there has come about a slight change in the attitude of teachers. The great war has brought this about in part, but this is not the only thing that has had an influence; something intangible—something difficult to locate—perhaps it is many sided—perhaps it is many things contributing to one end—something has opened the minds of many single-track men, and there is a gradual tendency towards broadening which is having its influence on college curricula, on the character of the papers read at the recent meetings of the great national societies, and to a slight extent on the subjects chosen for doctorates in biology in the universities. The recent founding of the Ecological Society of America is a strong evidence of the working of a leavening element; and the recent publication of such books as Cockerell's "Zoology," Needham's "General Biology," and Shull, Larue and Ruthven's "Principles of Animal Biology," and others, shows that the teaching mind is broadening.

I have mentioned the theses for doctorates. I have glanced over the titles of such theses, which represent the bulk of the graduate work in biology in American universities, for the past eight years, as published in the lists of the Library of Congress and in the journal SCIENCE. I find that only a very small percentage of this output represents work which can be of the slightest use to humanity in its immediate problems regarding the insect world, and even those which may prove of use bear some evidence that the lines of study had already been adopted by students who used them incidentally to gain their degrees and were not suggested by their teachers as promising lines leading toward some great practical outcome. .

How can we present a convincing argument on the necessity for a better rounded study of everything comprehended in the word *biology*! And how can we emphasize the prime importance of devoting our earliest attention to those problems which most immediately concern our well being? This can not be done authoritatively by a single individual. Perhaps a convert from the present religion, say an eminent authority on cell biology, with that enthusiasm characteristic of recent converts, could put the case more forcefully than could a man who has not achieved prominence in the now accepted lines of work. I am praying for such a convert. But much better than this would be a movement participated in by as many individuals as possible, all with the same general idea, each putting forward the views that have come to him in the course of his own restricted lines of study in biology.

Let us summarize. Few people realize the critical situation which exists at the present time. Men and nations have always struggled among themselves. War has seemed to be a necessity growing out of the ambition of the human race. It is too much, perhaps, to hope that the lesson which the world has recently learned in the years 1914 to 1918 will be strong enough to prevent the recurrence of international war; but, at all events, there is a war, not among human beings, but between all humanity and certain forces that are arrayed against it. Man is the dominant type on this terrestrial body; he has overcome most opposing animate forces; he has subdued or turned to his own use nearly all kinds of living creatures. There still remain, however, the bacteria and protozoa that carry disease and the enormous forces of injurious insects which attack him from every point and which constitute to-

day his greatest rivals in the control of nature. They threaten his life daily; they shorten his food supplies, both in his crops while they are growing and in such supplies after they are harvested and stored, in his meat animals, in his comfort, in his clothing, in his habitations, and in countless other ways. In many ways they are better fitted for existence on this earth than he is. They constitute a much older geological type, and it is a type which had persisted for countless years before he made his appearance, and this persistence has been due to characteristics which he does not possess and can not acquire—rapidity of multiplication, power of concealment, a defensive armor, and many other factors contribute to this persistence. With all this in view, it will be necessary for the human species to bring this great group of insects under control, and to do this will demand the services of skilled biologists—thousands of them. We have ignored these creatures to a certain extent on account of their small size, but their small size is one of the great elements of danger, is one of the great elements of success in existence and multiplication.

Let all the departments of biology in all of our universities and colleges consider this plain statement of the situation, and let them begin a concerted movement to train the men who are needed in this defensive and offensive campaign.

In closing, I can not refrain from quoting a remarkable paragraph from Maeterlinck:

> The insect does not belong to our world. The other animals, even the plants, in spite of their mute existence and the great secrets which they nourish, do not seem wholly strangers to us. In spite of all, we feel with them a certain sense of terrestrial fraternity. They surprise us, even make us marvel, but they fail to overthrow our basic concepts. The insect, on the other hand, brings with him something that does not seem to belong to the customs, the morale, the psychology of our globe. One would say that it comes from another planet, more monstrous, more energetic, more insensate, more atrocious, more infernal than ours. . . . It seizes upon life with an authority and a fecundity which nothing equals here below; we can not grasp the idea that it is a thought of that Nature of which we flatter ourselves that we are the favorite children. . . . There is, without doubt, with this amazement and this incomprehension, an I know not what of instinctive and profound inquietude inspired by these creatures, so incomparably better armed, better equipped than ourselves, these compressions of energy and activity which are our most mysterious enemies, our rivals in these latter hours, and perhaps our successors.

L. O. HOWARD
U. S. DEPARTMENT OF AGRICULTURE

ADDRESS AT THE LAYING OF THE CORNER STONE OF THE CHEMICAL LABORATORY OF THE CORNELL UNIVERSITY

THE great chemical laboratory, the cornerstone of which we lay to-day, will not be without its effect upon the life of the university. Its influence may be good or it may be bad. It is sure to be profound.

Chemistry has many aspects. Sordidly treated, as a mere bread and butter subject, it might conceivably tend to degrade our teaching to a low, materialistic level. Idealistically treated, as becomes a great fundamental science, it will promote the noblest purposes in education.

Are we out of touch with life? Chemistry has the most varied and intimate contacts with life of any of the sciences.

Do we wish to inspire, in our teaching, a passion for truth? The pursuit of science is an unending quest for truth.

Are we inclined to shun specialization lest we lose a certain breadth of training for our students? Let us remember that to really know something of any one of the many branches of a science like chemistry one must use several languages, must be something of a mathematician and physicist and must be acquainted with many allied subjects.

There are few things so broad as a "narrow specialty"—if you follow it down to the ends of its wide spreading roots!

As for the training of the imagination and the building of character, is it not inspiring to turn from the pitiful struggles of the human race as depicted in a world's history whose

every page drips with blood and filth, to the contemplation of the intimate structure of God's universe, perfect, complete; equally majestic whether we view it as a whole or in its minutest parts. It is indeed healthful for the imagination and for the character to delve, now and then into those unseen realms of nature through which wanders in speculative mood the spirit of modern science.

All of these things: the keeping in touch with life, the love of truth, the breadth of culture, the training of the imagination, the building of character are pedagogical considerations. But they are so important that the favorable influence of the new laboratory upon them would in itself make that great gift well worth while. Its real purpose, however, is much more momentous.

The new laboratory will be a center of research from the start. Of that we may be sure, knowing who are to occupy it. By its very completeness and adequacy, assured by years of careful and intelligent planning, it will challenge our chemists to redoubled activity. Enthusiasm and the true spirit of investigation are sure to prevail and notable results may be counted upon.

If the chemists and students of chemistry who are to work in this building attain only an average output as measured by the performance of university laboratories in the past, the donor may count on returns from his investment such as no commercial enterprise has ever paid. Nearly every fundamental discovery has originated in the universities and these discoveries have literally transformed the conditions of life upon our planet. In this transformation chemistry has had a great part.

The cost in money of these first essential steps towards progress has been but trifling.

The price of a single battleship would build twenty such great laboratories: that of a modern battle fleet, destined to the scrap heap within ten years, would amply endow all the universities in the land.

We can not remind ourselves too often of all this because these basic things which must precede all invention and industrial development are not ushered into the world with acclamation. Yesterday, so to speak, a quiet, shy little man in a university laboratory studied the emission of electrons from a hot body, described the phenomenon, wrote out the equations and went his way. To-day, as a consequence, you or I may speak to a friend in San Francisco. To-morrow, perhaps, we may be able to call up a man in any part of the world *and hear his living voice*: and very, very few will realize that *Richardson* made that miracle possible!

This is but one instance, and not from the domain of chemistry; were I a chemist and did time permit I could doubtless cite a hundred equally striking cases.

It is obviously difficult to estimate just what credit in the development of modern civilization is to be assigned to the workers in pure science but theirs is clearly an essential part. But for the new knowledge furnished by them modern civilization could not have come into being.

It may be thought that this is an evil day in which to boast of the triumphs of our civilization and that it were well if we could return to the primitive conditions of ancient Greece. I prefer, however, to regard the terrible upheaval which the human race has gone through as a violent attack of indigestion, due to having taken too rapidly into an unaccustomed system the rich new diet proffered by science. Let us hope for the ultimate recovery of the patient.

Measured according to that ultimate standard, which does not fluctuate with the abundance or scarcity of gold, *i.e.*, the happiness of the human race, I believe that the research man, academic trifler, theorist, dreamer, dabbler in things trivial as he seems to the man of affairs, will be found, like that other idle ne'er-do-well, the artist, to be among the most supremely productive of all the world's workers.

Speaking more intimately and personally, we may expect that the renewed activity of our chemists will react upon other departments. There will be joint projects for carrying on extended researches made possible by the new equipment. Thus we may soon hope

to enter upon what is perhaps the most promising next step in the development of the sciences: namely cooperative undertakings on a large scale involving chemistry-physics, chemistry-engineering, chemistry-geology, chemistry-biology, and the like. Many of the pressing problems of the immediate future are too large for any individual or for any single department. In this way, on its scientific side, the university may best serve the community. Thus it may better perform the prime function of every true university—the *advancement of knowledge.*

Edward L. Nichols
Cornell University

THE ORIGIN OF SOIL COLLOIDS AND THE REASON FOR THE EXISTENCE OF THIS STATE OF MATTERS

In the mechanical analysis of hundreds of samples of soil by the beaker method, the microscopical control of the subsidence of the clay group indicated that the smallest diameter of a clay particle is about 0.0001 mm. while the water from which the sediment subsided was clear and transparent.

At first thought it would appear that in a soil which has weathered under many agencies, such as the grinding of glacial ice, the abrasion of flood waters, the pounding of ocean waves, and other agencies of attrition due to soil movements operating through untold ages, material of every degree of fineness would accumulate, passing down below the limit of microscopic vision. Practically however this does not appear to be the case as the finest material of the soil, called the clay group, excluding the colloidal material, to be discussed later, ranges in diameter from .005 to .0001 mm. The question naturally arises as to what has become of the material of smaller size.

My present view is that particles of matter derived from silicate rocks and other soil-forming minerals when they approach a diameter of .0001 mm. contain relatively so few molecules that the bombardment of the water molecules in which the particle is immersed shatters the particle beyond the ability of the molecules in the solid to hold together as a solid mass. The atoms of calcium, magnesium, potassium and sodium in the molecule of the silicate would go for the most part into true solution, while the atoms of silicon, aluminum, and iron would go chiefly into colloidal solution forming the basis of the colloidal matter or the ultra clay of the soil. It should be possible for the mathematical physical chemist, from physical constants now known, to determine empirically the relative size of the particle of matter which could withstand such bombardment without complete disintegration. This is a problem which has not yet been worked out.[1]

There appears to be a certain equilibrium established between the colloidal state and the truly soluble state as there is always a small proportion of silicon, aluminum, and iron which seem to be in real solution, as they pass through a Pasteur-Chamberland filter and separate out on evaporating the solution not as a colloid but as an amorphous mass of hard scale-like material, like a boiler scale, without absorptive properties.

It is that portion of the silicon, aluminum, and iron which collects on the outside of the Pasteur-Chamberland filter in a truly colloidal condition which is recognized as the ultra clay.

This colloidal matter is very absorptive and takes into itself a considerable quantity of salts of calcium, magnesium, potassium, and

[1] Another way of looking at this is from the point of view of the internal energy of the system. The molecular attraction between the molecules of the solid and the molecular attraction between water molecules themselves and between the molecules of the solid and of the water must come to equilibrium. If the solid particle becomes relatively small in diameter there will be relatively few molecules in the solid to hold together against the attraction of the increasing number of water molecules surrounding them as the size of the solid particle diminishes. The attraction of water molecules for solids which it wets, as, for instance, glass, is seen in the relatively high temperatures and therefore high energies required to remove the *last traces* of water from the solid.

sodium which were in free solution but which are changed in the absorbing medium to a colloidal state in which they are extremely inactive and in which state they fail to respond to reagents that would normally reveal their presence. It is a matter of very great difficulty, therefore, to determine whether the electrolytes found in the ultimate analysis of the ultra-clay are constitutionally combined with the silicate of alumina and iron, or whether they merely exist in a passive colloidal state.

THE TRUE SOLUTION

The study of ultra clay includes fundamental problems of physical chemistry, particularly the differences in state between true solutions and colloidal solutions. The modern concept of solutions ascribes a rather complex form to the molecule of water. The molecule of a salt dissolved in water forms numerous and indefinite hydrates with the surrounding water molecules. The complexity of these hydrates is influenced by concentration and by temperature, or in other words by the balance in the internal energy of the system expressed by the activities of the water molecules on the one hand and the activities of the salt molecules on the other, as well as the activity or energy exerted between the water molecules and the salt molecules.

Little is known about the complexity of the hydrates in the solution. We have actual data only when certain salts crystallize from the solution. With salts that crystallize with water of hydration the lowest hydrates are formed at the higher temperatures and the higher hydrates are formed at the lower temperatures. Magnesium chloride is known to crystallize with five different amounts of water, namely, 2, 4, 6, 8, and 12 H_2O. The higher hydrate (12 H_2O) separates at temperatures between 16.8° to —33.6° C. The lowest hydrate comes out at 181.5° C.

Sodium carbonate is known with three states of hydration, namely, 1, 7, and 10 H_2O, depending upon the temperature. If intermediate hydrates occur they do not appear to be stable forms. It would appear therefore that 12 H_2O is the highest stable hydrate formed in crystals except for the double molecules of the alums which carry twice this amount or 24 H_2O. Sodium chloride crystallizes out at ordinary temperatures without water of hydration, the crystal being completely dry on the inside. It is said to crystallize with 2 H_2O at temperatures somewhat below zero. Sodium sulphate crystallizing at room temperature immediately changes under the same temperature conditions to the anhydrous form when the solution becomes saturated with sodium chloride. This gives us a vision of only a few proportions of water which fit into the molecular structure of the crystal in permanent form. It throws no other light upon proportions of water of hydration which may occur in solution which would not fit into the structure of a crystal in stable form.

The strength of these hydrates differs markedly. Sodium carbonate with 10 H_2O on exposure to air is reduced to sodium carbonate with 1 H_2O. Sodium sulphate with 10 H_2O gives off free water under pressure as when pestled. Any of the three known hydrates of calcium chloride, namely, 2, 4, 6 H_2O, absorbs water when exposed to ordinary air, which changes from a gaseous to a liquid state in which the calcium chloride finally dissolves.

It appears therefore that the water of hydration is influenced by the internal energy of the system and may be modified by the external pressure of the water vapor in the air and by mechanical force.

There are of course numerous cases where salts crystallize without water of hydration or where they come down in the form of amorphous material without crystalline form. There are likewise numerous cases where it is difficult to secure crystals and often impossible to separate material in a solid state which ordinarily comes out in a solid form. The difficulties in obtaining sugar in a solid form with certain impurities, particularly glucose and potassium, or iron, is a case in point. The impossibility of obtaining ortho-

phosphoric acid in a solid state from solutions containing certain impurities is another case in point.

Many of the salts which contain water of crystallization, especially the sulphate carbonate, and acetate of sodium, are remarkable for the fact that when solutions are prepared free from dust and under perfectly quiescent conditions they refuse to crystallize far below their ordinary point of saturation unless they are disturbed by agitation, by particles of dust or particularly by introduction of crystals of the material, when they suddenly crystallize throughout the entire mass. Jeannel years ago stated that he assumes "that saturated solutions when heated form peculiar hydrates and that these remain unaltered when the temperature is lowered but that vibration or the presence of a crystal of the salt is sufficient to bring about their decomposition."

It has been observed by Ostwald that previous to the formation of sodium chloride crystals points of congestion may be noted where droplets form and can be seen under the ultra microscope. This is analogous to the suspensoid form of droplet of a colloidal body, but while the colloidal droplet is stopped from going further the sodium chloride droplet completes its course by coming together into a crystalline mass with the complete exclusion of the water of hydration which has surrounded the molecule in its solution state. Under conditions of supersaturation above referred to it is supposed that these centers of congestion are avoided and crystallization does not occur until by agitation or the introduction of nuclei such centers of congestion are brought about.

COLLOID SOLUTIONS

It would appear that the colloidal state of the silicon, aluminum, and iron is such, the hydrates formed with the water molecules are so complex and the internal energy of the system is so low that the molecules of silicon, aluminum, and iron, and the same would probably be true for colloidal platinum, gold and silver, are unable at ordinary temperatures to combine as a crystalline or amorphous mass. If the temperature is raised to 900 or 1000° the last traces of water disappear, they lose completely their colloidal properties and take on the form of an amorphous mass.

The modern concept of the atom shows a central nucleus charged with positive electricity surrounded by many electrons with negative charges. If the two forces are perfectly balanced the material is inert as in the case of nitrogen gas. The activity of the atoms of other elements depends upon the extent to which this balance is thrown off to one side or the other.

From the modern concept of solutions it would appear that the silicon, aluminum and iron are completely dissociated in their colloidal solution but the positive and the negative portions of the molecules are so balanced that they are in an extremely inactive condition and substances absorbed by them become equally inert and inactive for the same cause and thus change their state from a condition of true solution to a colloidal solution.

The principles of dyeing appear to be based upon a similar change of state. The dye in true solution enters a colloidal membrane such as silk or wool, is changed to a colloidal state in and on the membrane from which it can not thereafter be dislodged with water as the colloidal solution is immiscible with water. The principles of dyeing seem to rest upon the ability of certain materials including mordants which are of such conditions that they have the power to bring about this change of state.

The colloidal material separated from soils in a dilution not exceeding one gram per liter after thorough agitation appears under the ultra microscope as minute droplets showing points of congestion such as precede the formation of salt crystals and appear as droplets of fat suspended in milk or as fog appears in the cloud. In larger concentrations these droplets coalesce into larger masses as the fat globules coalesce on rising into cream or as the droplets of fog coalesce to form the liquid water of larger drops. Fog follows neither the laws of gases nor the laws of liquids. The soil colloid

in suspension in water may be coalesced by salt or lime solutions but the change is not sufficient to overcome the colloidal state as in the case of the coalescence of the fog particles into liquid water, and on removing the coagulating agency the colloidal matter may again be put in suspension.

As before stated the only means yet discovered to change the colloidal nature of the soil colloids is through an enormous expenditure of energy in heating the material to 900° or 1000° to completely drive off the water of hydration and leave the material an amorphous mass lacking entirely colloidal properties. This is too expensive a method to be used in agriculture or in road construction to particularly affect the plasticity of the wet clays. The problem before the soil chemist and the road engineer is to bring about a change in the internal energy of the soil colloid so as to break up the complex hydrates and permit the atoms or molecules of silicon, aluminum, and iron to form a crystalline or an amorphous solid and thus make the extremely plastic clays less plastic and more friable.

The molecular weights of colloids determined from diffusion or from freezing point are very high, reaching the figure 25,000 for starch. The question arises as to whether this figure is applicable to the molecule of the anhydrous colloid or to the colloidal molecule associated with the extremely complex system of hydrates that have attached themselves to the molecule of the colloidal substance. Numerous cases have been reported where zeolites have formed after the percolation of soil moisture through exceedingly small openings in rocks and building stones. The question arises as to whether sufficient force can be exerted to force a colloidal solution through openings too small to carry the associated water of hydration, and whether under these conditions, like the stirring of a supersaturated solution, the molecules of the colloid could be brought sufficiently close to combine into a crystalline or amorphous solid.

This is of theoretical interest only. The practical problem seems to be to find some cheap method of breaking up the complex hydrates to give the atoms of silicon, aluminum and iron, or the hydrated molecules of the silicate an opportunity to combine in a solid form.

Milton Whitney
Bureau of Soils,
Department of Agriculture

WHEN WILL THE TEACHING OF CHEMISTRY BECOME A SCIENCE?[1]

When will the teaching of chemistry become a science? Before answering this question, let us ask another question. When did chemistry become a science? Chemistry became a science when men found that there were different elements; that these elements had different properties; that they could be changed into different forms; that they would react with one another and give different products and that in all these interactions and transformations there was no loss or gain of mass. These are a few of the fundamental conceptions that were necessary before chemistry could become a science.

The teaching of chemistry will become a science when we as teachers recognize that every student is possessed with certain original tendencies with which we are to work just as the chemist works with the elements. These original tendencies are subject to transformations and interactions, but they can not be destroyed any more than an element. The law of the conservation of mass holds. Sometimes the psychologist speaks of an original tendency being eliminated. He means by this that the tendency has been so modified that you can not recognize it. The chemist would say that it had suffered a chemical change or had been changed into an allotropic form.

For the benefit of those people who studied psychology some years ago, I might say that a few of these original tendencies are curiosity, manipulation, mastery, fear, sex instinct, hoarding, ownership, etc. These are the rocks upon which we build our chemical

[1] Read before the Section of Chemical Education, American Chemical Society, New York, September 8, 1921.

structure, and hence in our teaching of chemistry, we must hew these rocks into shape by the use of chemical tools. You may ask what do you mean by this and how may it be done? To illustrate, I will take the first tendency which I mentioned, namely, curiosity.

There is not a normal boy or girl who has not an original tendency to want to know the reason or wherefore of almost everything with which they come in contact. As they begin their school days this tendency is gradually transformed into a submissive tendency by the teacher's desire to not wish to be bothered with so many questions, and when the student reaches the chemistry department, we generally put the finished transformation touch to it, and hence we have destroyed the properties of one of the most energizing elements in the promotion of chemical education.

If we find that a student, when he comes to our chemistry department, has had this tendency partly transformed, it should be our business as teachers of chemistry to bring back or revert this original tendency to its pure condition. Now, you ask me how this may be done. I can tell you how it can not be done. It will never be done by telling the student all the results or letting him read all the results before he goes to the laboratory, that is, by letting him go to the laboratory with the feeling that his experiments are only to illustrate the lecture or book. Such work is highly artificial and not only dulls the keen observations of the student, but absolutely tends to kill all curiosity. To be sure life is too short to find out everything in the laboratory, but what he can find out and has time to find out let him find out without telling him. What he does not have time to find out or can not find out, tell him in plain English. A few things found out for himself will stimulate and augment his curiosity, and put him in an appreciative attitude for results told him. Hence I say that we as chemists can develop this original tendency of curiosity by the proper handling of the laboratory end of chemistry. This must be put up in such a way as to arouse the student's curiosity. This may be done by putting all laboratory work in problem form and letting that problem be one that has not been explained over and over and over again in both lecture and book. You may call this a project in spite of the fact that we understand that a project is a piece of work carried out in its natural setting. The laboratory is a natural setting in the study of chemistry.

I feel that the project or problem method produces the most favorable conditions or situations for arousing and holding the original tendency of curiosity, and furthermore I am sure that this same feeling is shared by many others, and because of this fact I can not understand why it is not more generally used.

I am of the opinion that the entire chemistry course can be developed by the project method. Let the reading matter raise a problem or project, and then let this project be straightened out by a little elementary research. When he has solved his problem or project his book reads smoothly, and when he has solved all the projects in the book his book is complete, and it is not complete until he has. He must do his share before he can gain a full knowledge of his subject. Such a situation produces a normal curiosity, and at the same time there is a very noticeable improvement in his observations and powers of reasoning, both of which are so essential to a chemist.

The teaching of chemistry will become a science when chemistry teachers begin to seek for the situations or conditions that will properly develop all these original tendencies which are closely allied with chemistry. When, we, as chemists, have found the conditions or situations that produce certain results with the elements of chemistry, what do you do? You publish these results or come to such a meeting as this and give other chemists the benefit of your results. Why should you not do likewise when you have found the proper conditions for the development of these original tendencies?

I have mentioned one situation for the development of curiosity. I hope that next year someone else will give us a better situation for its development, and some other men will give us chemical situations for the development of some other original tendencies. When we get all these situations worked out from a chemical standpoint we can tell what situation to put up to get a certain response from a given original tendency just as the chemist knows that he will get a certain reaction from a given element when he subjects it to a certain situation or condition.

When we all have gone back to the student and begun to develop the teaching of chemistry on original tendencies, the teaching of chemistry will become a science, and nothing will hasten that day more than meeting together in an open forum as we have done this week. It is a pity that the teaching of chemistry is not recognized fully as a profession, but no one is at fault but ourselves. Let us become worthy of the profession by studying the teaching of chemistry in a scientific way, and then people will not hesitate to give the calling of teaching chemistry a proper place and the college professor a living wage.

Neil E. Gordon

University of Maryland,
College Park, Md.

SCIENTIFIC EVENTS

EARL JEROME GRIMES

The executive committee of the Association of Virginia Biologists has adopted the following minute:

The executive committee of the Association of Virginia Biologists has heard with deep regret of the death of Earl Jerome Grimes, associate professor of biology in the College of William and Mary. Less than a month ago he was present in our fall meeting and contributed largely to its success. By his death the College of William and Mary has been deprived of a faithful and inspiring teacher; this association of a valued member and counselor; and the science of botany of a young disciple of great promise. To his family and to his college we wish to express our most heartfelt sympathy in their great loss.

This minute we instruct the secretary to spread on the records of the association, to have published in Science, and to communicate it to Mrs. Grimes and to the faculty of the College of William and Mary.

ELECTRIC POWER MAPS

A map of New York State showing the location of the power stations and electrical transmission lines used by public utility companies has been published by the United States Geological Survey, Department of the Interior. It was originally planned to publish these maps as plates in water-supply papers, which were also to contain tabular information in regard to the equipment of the power stations and the chief characteristics of the transmission lines, but to avoid the expense and delay incident to the publication of such reports the maps will be issued separately and sold. The map of New York State is the first one to be published and may be bought for one dollar from the director of the United States Geological Survey at Washington. The base map used is the Geological Survey's map of the state, 64 inches long and 45 inches wide, scale 1:500,000. The map shows the location of the stations and primary transmission lines and bears a numbered list of the power companies, the numbers corresponding to numbers assigned to the stations on the map. Proof maps were first made and sections of them were sent to the companies for correction or revision. Similar maps of New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, Maine, New Jersey, Pennsylvania, Maryland and Delaware are in course of preparation. These maps will be valuable to those who are studying interconnection of power companies and to those who wish to establish manufacturing plants within reach of electric power—in fact, they will be useful to any one contemplating the use of power in any way.

MEDALS OF THE ROYAL SOCIETY

At the anniversary meeting of the Royal Society on November 30, Professor Sherrington presented the medals (we quote from *Nature*) as follows: The Copley medal to

Sir Joseph Larmor, who has long held a leading position in the British school of mathematical physics. It may fairly be said that his preliminary work was of the utmost value in paving the way to the modern developments of the theory of relativity. A Royal medal to Dr. Frederick Frost Blackman, distinguished for his contributions to plant physiology, and especially to knowledge of the process of photo-synthetic assimilation of carbon dioxide. A Royal medal to Sir Frank Dyson, who has devoted special attention to investigations of the movements and distances of the stars and of the bearing of these upon the structure of the stellar universe. It was mainly to his foresight and organizing ability that we owe the successful observations of the deflection of light by the sun's gravitational field during the eclipse of 1919. The Davy medal to Prof. Phillipe Auguste Guye, in recognition of his work on optically active organic substances, on molecular association, and on atomic weights. The Hughes medal to Prof. Niels Bohr, the author of the conception to which the name "Bohr-atom" has been attached. This conception gave a solution of the long-standing puzzle of the Balmer series of hydrogen, and appears likely to provide a complete explanation of the spectra of the various elements.

SCIENTIFIC NOTES AND NEWS

DR. L. O. HOWARD, chief of the Division of Entomology of the U. S. Department of Agriculture, gave at Toronto on the evening of December 27 the address of the retiring president of the American Association for the Advancement of Science, which is printed in the present issue of SCIENCE. We hope to print in subsequent issues the addresses of the chairmen of the sections and other addresses and proceedings that are of general interest.

AT the last meeting of the Indiana Academy of Science held at Indianapolis, Indiana, Dec. 1 and 2, 1921, the following officers were elected:

President: F. M. Andrews, Indiana University.

Vice-president: C. A. Behrens, Purdue University.

Secretary: W. N. Hess, De Pauw University.

Assistant Secretary: H. T. Dietz, Indianapolis, Indiana.

Treasurer: W. M. Blanchard, De Pauw University.

Editor: F. Payne, Indiana University.

Press Secretary: F. B. Wade, Shortridge High School, Indianapolis, Indiana.

THE recent election of the Optical Society of America resulted in the choice of the following officers for terms beginning January 1, 1922:

President (2 year term): Leonard T. Troland, Harvard University.

Vice-president (2 year term): Herbert E. Ives, Western Electric Company, New York.

Secretary (5 year term): Irwin G. Priest, National Bureau of Standards.

Treasurer (5 year term): Adolph Lomb, Bausch and Lomb.

Members of the Executive Council (2 year term): Adelbert Ames, Jr., Dartmouth College, W. E. Forsythe, Nela Research Laboratories, Henry G. Gale, University of Chicago, Ernest Merritt, Cornell University.

The retiring president, Professor J. P. C. Southall and all of the above-named officers are ex-officio members of the Executive Council.

AT its 1921 meeting at New Orleans, the American Pharmaceutical Association awarded the 1921–22 grant from the A. Ph. A. Research Fund to Dr. David I. Macht, of the Johns Hopkins University, for pharmacological work on the benzyl compounds found in certain galenicals. The first grant made in 1919 was awarded to Dr. George D. Beal, of the University of Illinois, for work on alkaloidal assays, while the 1920 award was made jointly to Dr. Herber W. Youngken, of the Philadelphia College of Pharmacy and Sciences, for work on aconite varieties and Dr. E. Kremers and Miss Lila Winkelblech, of the school of pharmacy of the University of Wisconsin, for work on derivatives of guaiacol.

R. L. AGASSIZ, of Boston, was elected president of the Copper and Brass Research As-

sociation, at its first annual meeting held in New York, December 6.

Dr. Walter Lawrence Bierring, Des Moines, Iowa, has been elected an honorary member of the Royal College of Physicians of Edinburgh, "to mark its sense of his distinguished services in connection with reciprocity" between the United States and Great Britain in matters of medical education.

Dr. Niels Bohr (Copenhagen), Dr. Johan Hjort, head of the Norwegian Fisheries, and Professor Paul Langevin (Paris) have been elected honorary members of the Royal Institution.

Dr. B. E. Eldred of New York has recently been awarded the Elliott Cresson gold medal of the Franklin Institute, Philadelphia, for his development of the low-expansion leading-in wire for incandescent electric lamps.

The *Journal* of the Washington Academy of Sciences states that Mr. George M. Rommel, chief of the animal husbandry division of the Bureau of Animal Industry, U. S. Department of Agriculture, has resigned to become editor-in-chief of the American International Publishers, New York City. Mr. Rommel had been with the Department since 1901, and had been chief of his division since its organization in 1910.

Captain Ernest L. Bennett, formerly in command of the battleship *New York*, has been designated by the Navy Department as director of the naval experimental and research laboratory now nearing completion at Belleview, on the Potomac River below Washington.

Dr. George H. Whipple, dean of the University of Rochester Medical School, will deliver the fourth Harvey Society Lecture at the New York Academy of Medicine, on Saturday evening, January 7. His subject will be "Pigment metabolism and regeneration of hemoglobin in the body."

Before a meeting of the Chemical Society of the District of Columbia, at the Cosmos Club in Washington on December 8, Dr. H. V. Moore, chief chemist of the Bureau of Mines, spoke on "Radium," Dr. Howard A. Kelley on "The Therapeutic Use of Radium in the Treatment of Cancer," and Miss Armstrong of the Bureau of Standards on "The Quantitative Measurement of Radium."

At a meeting of the Faraday Society on December 13, Professor F. O. Rankine delivered an address on "The Structure of Gaseous Molecules."

The Anglo-Batavian Society has proposed an extension of the scheme for the interchange of lectures between England and Holland and has suggested a course of eight lectures from the British side this session. The University of London has nominated Professor F. G. Donnan and Dr. J. F. Thorpe as lecturers in chemistry.

Joseph E. Goodrich, head of the agricultural department of the Loomis Institute, Windsor, Conn., died on December 21 at the age of forty years.

Mr. James Robert Appleyard, of the Royal Technical Institute, died on November 26, in Manchester, England, at the age of fifty-two years.

Wallace Lee has been appointed chief geologist to the Government of Siam. For the present his address is in care of the Commissioner General, Royal Railroad Department, Bangkok, Siam.

The directors of the Fenger Memorial Fund have set aside $500 for medical investigation. The work should have a clinical bearing and if possible it should be carried out in an institution that will furnish facilities and ordinary supplies free of cost. Applications with full particulars should be sent to L. Hektoen, 637 S. Wood Street, Chicago, before January 15, 1922.

Stanley Field, president of the Field Museum, Chicago, and nephew of Marshall Field, has contributed $265,000 to the museum. Captain Marshall Field has pledged $50,000 a year for five years; Charles R. Crane has given $30,000 and Arthur B. Jones $25,000.

THE seventeenth annual New England Intercollegiate Geologic Excursion was held October 15 at Attleboro, Massachusetts, under the leadership of Professor J. B. Woodworth of Harvard University. Forty-eight persons representing thirteen institutions were present. The institutions represented were as follows: Associated Petroleum Engineers, Brown University, Colby College, College of Education, Providence, Harvard University, Massachusetts Agricultural College, Mount Holyoke College, Tufts College, University of Vermont, University of Washington, United States Geological Survey, Wesleyan University, and Yale University. The group visited the exposures of Dighton conglomerate in the vicinity, of Attleboro, the Wamsuuta series consisting of red shales, felsites and diabases in South Attleboro, the Cambrian outcrops at Hoppin Hill, the shale series of the Coal Measures near the station at Plainville containing fossil plants and amphibian footprints, and other minor localities in the vicinity of Red Rock Hill and Oldtown. Plans were discussed for the eighteenth excursion which will be held in the vicinity either of Amherst or Worchester, Massachusetts.

WE learn from the *Journal* of the American Medical Association that the board of directors of the Gorgas Memorial Institute at the national headquarters in Washington has elected the following officers: Dr. William C. Braisted, president; Dr. Franklin Martin, vice-president; Dr. Arthur P. Robbins, Burlington, Iowa, executive secretary, and Mr. Edward J. Stellwagen, president of the Union Trust Company, Washington, treasurer. The purpose of the organization of an executive committee is to further a movement to introduce the sanitary methods devised by the late Surgeon-General Gorgas in all the civilized countries of the world. Word was recently received by the institute that Dr. Richard P. Strong, dean of the department of tropical medicine of Harvard University and former director of the biologic laboratory at Manila has accepted the post of scientific director of the Gorgas Memorial Institute of Tropical and Preventive Medicine to be built at Panama City on a site presented to the United States by Dr. Belisario Porras, president of the Republic of Panama. The presentation of the site was made recently in Philadelphia by José Lefevre, chargé d'affaires of Panama at Washington.

DR. CHARLES H. GILBERT, of the Bureau of Fisheries, and Field Assistant Henry O'Malley have returned from an extensive trip to Alaska, which was devoted to a study of the runs of salmon in the southeastern and central districts. Special attention was given to the salmon of Kodiak Island, where a rack had been constructed in Karluk River early in the season and the counting of red salmon ascending the stream was being carried on. It is reported that up to September 17, the total escapement of red salmon up the river was 1,322,000. Dr. Gilbert advises that the investigations in the Karluk region were most interesting and profitable. Every spawning stream tributary to Karluk Lake was examined.

EDUCATIONAL NOTES AND NEWS

THE American Association of University Professors meet at Pittsburgh on December 29 and 30 in association with the national societies devoted to the economic and social sciences.

DR. THEODORE LYMAN, director of the Jefferson Physical Laboratory of Harvard University and professor of physics since 1913, has been made Hollis professor of mathematics and natural philosophy. He is the ninth incumbent of this foundation, which was established by Thomas Hollis in 1727. Lyman's three immediate predecessors were Joseph Lovering, 1838–1888, and Lyman's teachers and friends, B. O. Pierce, 1888–1914, and Wallace C. Sabine, 1914–1919.

PROFESSOR HAROLD J. LOCKWOOD has been appointed professor of electrical engineering in the Thayer School of Engineering of Dartmouth College, to fill the vacancy caused by the resignation of Professor F. E. Austin.

Dr. Sydney Robothan Miller, associate professor of clinical medicine in the Johns Hopkins Medical School and president of the American Congress of Internal Medicine, has joined the staff of the University of Maryland School of Medicine.

Dr. W. Magner has accepted the position of director of the pathological department of the University of Toronto. He was formerly lecturer on pathology in University College, Cork.

DISCUSSION AND CORRESPONDENCE

THE ACQUISITIVE INSTINCT IN CHILDREN AS AN EDUCATIONAL STIMULUS

The educational value of the collections of various objects which children form has not received the universal recognition which it so well merits. The tendency to form collections of such objects as stamps, coins, post cards and bird's eggs has as its basis the instinct of acquisition. A child of two years hoards bits of cloth, clothes pins, and buttons without knowing why he does it. The object appeals to the child's senses, that is, the perception of the object stimulates his instinctive desire for possession.

Sometimes an epidemic of collecting will arise in a neighborhood as occurred in a suburb of Chicago, a few years ago, when most boys between the ages of eight and fourteen collected the pictures of baseball players coming with certain brands of tobacco. Boys collected the pictures because they saw others doing it, and because of that instinctive craving for things which please the senses. Here rivalry appeared. Boys vied with each other to see who could get the greatest number of pictures, and a value was placed upon them far in excess of their intrinsic worth.

The desire to collect without a definite purpose other than to see how many objects can be brought together continues into adolescence. At the age of twelve or thirteen, however, collections often assume an emotional character as those made up of souvenir spoons, theater ticket stubs, or later dance programs.

Up to this stage the instincts of acquisition, imitation, and emulation have furnished the stimulus for the collective mania, and even in collections of natural objects, reasoning has not played a basal part. Judgments were formed as to relative value, methods of acquisition, and arrangement of the objects, but as yet the purpose of collecting for systematic arrangement and study has not appeared.

Consider now the case of the stamp collector who has outgrown the desire for mere numbers. He considers methods of arrangment other than size or color, considering country and time of greater moment. He associates designs with historical events, and the portraits with national heroes. He notices the evolution of symbols and designs appearing on succeeding issues of stamps, as well as the progress made in printing and engraving from the earlier to the more modern representatives. Here is being developed the "scientific attitude of the mind," the expression of that desire to classify, arrange, and correlate fact. The comparing of concepts, of memory images, the formation of judgments, and reasoning enter into the mental process, while instinct is eclipsed by thought. Such a collection will furnish many lessons in reasoning; for in solving the problems arising in classification the habit of consistent thinking is materially aided.

Collections of natural objects as butterflies, shells, and leaves have an especially favorable influence upon the thought habit, but only if the desire to arrange and study systematically is present. The classification problems met with are so diverse and require such varied methods of approach that the training received in meeting them necessitates intense thought and a strong purpose.

It should be remembered, therefore, that a child's mania for collecting is the normal expression of an instinct; that this instinct can be diverted into emotional or intellectual channels; that when diverted intelligently it may be a great factor in the formation of the thought habit, the great purpose in any education. It seems well worth while to con-

sider methods by which the acquisitive instinct in children may be diverted by encouragement and suggestion so as to prove the stimulus for the higher forms of intellect.

WILLIAM DRUMM JOHNSTON, JR.
WALKER MUSEUM, UNIVERSITY OF CHICAGO

LINKAGE IN POULTRY

Two genes each of which is sex-linked must obviously be completely linked in the gametogenesis of the sex which is heterozygous for the sex gene. On Morgan's theory of inheritance they should also be partially linked in the homozygous sex, as in the female of *Drosophila*. I therefore decided to test for linkage between two well-known sex-linked genes of poultry, namely B, whose presence causes barring of melanic feathers, and S, which by inhibiting yellow pigmentation, converts "gold" into "silver" hackle feathers. A Brown Leghorn cock of composition bs/bs was therefore mated to Barred Plymouth Rock hens of composition BS. Their male children were of composition BS/bs. These were mated to bs Brown Leghorn hens, and have so far produced:

30 Barred silver BS/bs ♂ and BS ♀
17 Unbarred silver bS/bs ♂ and bS ♀
10 Barred gold Bs/bs ♂ and Bs ♀
21 Unbarred gold bs/bs ♂ and bs ♀

This corresponds to a series of spermatozoa 30 BS, 17 bS, 10 Bs, 21 bs, or 27 cross-overs out of 78. The cross-over value is therefore 34.6 per cent. with a probable error of 3.6 per cent., that is to say there is undoubtedly linkage. The numbers of barred and unbarred are practically equal, but there is a 50 per cent. excess of silver over gold, perhaps due to selective mortality.

The experiment is being continued, and it is hoped next year to obtain repulsion as well as coupling. If Pearl is correct in his view that one of the genes for high egg-laying is carried in the sex-chromosome, the economic importance of mapping it is considerable. For example if the locus of the egg-laying gene L_2 lies between those of B and S, then if B and S have been transferred together from a race of high-laying power to one of low-laying power, we shall know without further testing that, except in the rare cases of double crossing-over, L_2 has been transferred with them.

J. B. S. HALDANE
NEW COLLEGE,
OXFORD, ENGLAND

THE ZOOLOGICAL RECORD

The Zoological Record, which was founded in 1864 by English zoologists, has been issued regularly ever since and contains each year a complete bibliography of all publications connected with zoology. It is now the sole work of the kind, and is invaluable to all workers in every branch of zoology.

Previous to 1914 *The Zoological Record* formed part of the "International Catalogue of Scientific Literature," and was issued under the joint responsibility of the Royal Society and the Zoological Society. As the Royal Society found itself unable to proceed with the volumes of the "International Catalogue" after the issue for 1914, the Zoological Society has undertaken to prepare and issue the volumes for 1915–1920 inclusive at its sole financial risk.

It is the wish of the record committee of the Zoological Society to continue the publication of this most useful work, but it is obvious that they can not expect the Society to undertake the heavy financial liability involved in publication unless they receive reasonable support from working zoologists both at home and abroad.

I hope, therefore, that all working zoologists who agree with me that the suspension of the publication of the *Record* would have a most disastrous effect on the progress of zoology, will either subscribe themselves or will urge the librarians of the institutions with which they are connected to do so.

A prospectus and form of subscription either for the whole or separate divisions of the *Record* can be had on application to the Zoological Society.

W. L. SCLATER,
Editor
ZOOLOGICAL SOCIETY OF LONDON,
LONDON, N. W. 8

METEOROLOGISCHE ZEITSCHRIFT

IN a letter received from Professor V. Conrad, the recently elected secretary of the

Austrian Meteorological Society, he expresses the fear that the *Meteorologische Zeitschrift* may cease publication for want of funds. This would be a deplorable circumstance and a distinct loss to meteorology and science. He asks for subscriptions, the price being only $3.20 U. S. currency per year. It is hoped that this note may secure not only renewals, temporarily dropped during the war, but also new subscriptions, so that this valuable periodical may be saved from extinction.

OTTO KLOTZ

DOMINION OBSERVATORY,
December 6

SCIENTIFIC BOOKS

RECENT ADVANCES IN PALEOPATHOLOGY

AN important contribution to the study of the origin and evolution of diseased conditions is contained in the recent volume by Dr. John M. Clarke[1] whose previous studies on this subject have enriched the literature of paleopathology.[2] He has, in the present essay, given a popularized account of his accurate paleontological studies, dealing with the nature of disease and the geological indications of its evolution. He calls attention specifically to the fact that there has been an evolution of disease similar to the evolution of organic forms. Certainly the evidence points to a progressive increase in pathological conditions throughout the geological ages.

Dr. Clarke's evidences are all selected from the field of invertebrate fossils in which his wide acquaintance with invertebrate paleontology and stratigraphy gives his opinion the greater weight. Only a specialist in this field would be able to discriminate benign pathological conditions from those of accidental post-fossilization erosions.

The author has a deeper purpose in view than merely contributing to the subject of paleopathology and his essay is a philosophical study of the nature of symbiotic and parasitic conditions of the ancient Paleozoic world.

Ths subject has been further enriched by the appearance of another volume dealing with the evidence of disease during a more recent period of the world's history.[3] This volume was prepared under the supervision of Lady Alice Ruffer of Ramleh, Egypt, as a memorial to her husband who lost his life in the recent war. The volume consists of nineteen essays which had been previously published in various journals, chiefly the *Journal of Pathology and Bacteriology.* These deal with detailed accounts of Sir Ruffer's studies on ancient Egyptian mummies; one paper relating to a condition of spondylitis deformans in a crocodile from the Miocene of Egypt.

These reprinted essays are accompanied by a brief biographical sketch and a list of Ruffer's writings.

Ancient Peru has contributed greatly to our knowledge of paleopathology, and the civilizations of the Incas and their predecessors have a diligent student in Edmundo Escomel,[4] a practising physician in Arequipa, Peru. His most recent contributions deal with discussions of the ancient surgical art of Peru; the instruments and results obtained, seen especially well in the numerous trephined skulls of the ancient Peruvian burials.

ROY L. MOODIE

UNIVERSITY OF ILLINOIS,
CHICAGO

SPECIAL ARTICLES

A SIMPLE METHOD OF OBTAINING PREMATURE EGGS FROM BIRDS

IN connection with studies on the relation of the endocrine glands to sex and reproduc-

[1] "Organic Dependence and Disease: Their Origin and Significance," Yale University Press, October, 1921, pp. 1–113; 105 figures.

[2] "The Beginnings of Dependent Life," Fourth Annual Report, State Museum of New York, 1908, pp. 1–28, 13 plates and text-figures.

[3] Sir Marc Armand Ruffer, "Studies in the Palaeopathology of Egypt," University of Chicago Press, October, 1921, pp. i–xx and 1–371; illustrated by 71 plates.

[4] Dr. Edmundo Escomel, "Ciencia y arte en le prehistoria peruana," printed privately, Lima, Peru.

tion it was observed some months ago that injections of therapeutic doses of the active principle of the posterior lobe of the pituitary body sometimes causes a premature expulsion of the bird's egg from the oviduct. Soon afterward it was easily established that a somewhat larger dosage could be relied upon to cause an immediate expulsion of the egg from any part of the oviduct. Doubtless this action might have been anticipated from the well-known action of this secretion on the uterine muscle of mammals. The immature or oviducal egg can be utilized to much advantage in the investigation of several kinds of biological and chemical problems but the impracticability of obtaining such eggs—except through the often uncertain, ever expensive and self-limiting process of killing the mother bird—has hitherto handicapped such studies. It therefore seems worth while to describe this simple and useful method.

A full understanding of the method and its limitations involves the following facts concerning the premature egg: The bird's egg requires between 1 and 2 days to pass from the ovary to the exterior. In pigeons this period of passage down the oviduct is a little more than 40 hours. When the ovarian egg is laid it has therefore already undergone development during this number of hours and has had various accessory parts (albumen, shell-membranes, shell) added to it. The first 10 to 15 hours of this period involve the formation of albumen, while the shell is continually formed during the last 25 to 30 hours. The middle and lower portions of the oviduct are more highly muscular in structure than is the extreme upper portion (infundibulum, funnel) into which the egg first passes from the ovary. The movements which propel the egg along the oviduct are involuntary in origin; in the final muscular act of egg-expulsion voluntary action is also involved. In the dove or pigeon the egg is easily and positively palpable 30 hours before the normal time of laying.

The effectiveness of the method is sufficiently indicated in the table which has been constructed from the last series of injections made by us. It will be observed that, with few exceptions, the eggs were laid within 6½ to 25 minutes following the injection. They were laid at stages of immaturity varying from 4 to 26 hours. Four cases required a repetition of the injection. The egg sought at the 37-hour stage (No. 8) was not forced backward but forward into the body cavity—a fact later verified by abdominal operation. A 34-hour stage (No. 11) was, however, forced neither forward nor backward by a dosage one-half of that used in the other tests. In the case of one quite wild common pigeon (No. 14), injected late at night, three injections failed to cause the immediate extrusion of the egg, though they quickly forced the egg down to the extreme posterior part of the oviduct. The time limits involved in this case are uncertain. Egg No. 6 was laid without shell but with the membrane. Several eggs had very little shell while those taken only 4 to 10 hours before the normal period of laying were fairly provided with shell and were capable of incubation in the normal manner. The injections are nearly as effective in the common fowl, though in this case it is not possible to know the exact number of hours of immaturity of the egg thus secured.

The injections are made hypodermically (No. 1) or better intramuscularly into the broad muscles of the breast. Pituitrin of Parke, Davis and Co. was used in the injections cited in the table. It is unnecessary to use the preparation designed for use in obstetrics (used here in Nos. 9, 10, 11, 15, 16, 17) since the difficulty of infecting birds makes the use of pituitrin (oral) practicable. The size of the effective dose depends largely upon the age of the preparation. One preparation evidently made six months later than another was found to be twice as active as the older preparation. The dosage for the weaker preparation, which is perhaps near the average age of preparations on the market, was found (it was used in data of table) to be about 0.133 c.c. per kilo body weight. This dosage is about 4 times that used for

a limited period by us in a current study of the possible rôle of pituitary deficiency in reproductive disorders in birds. Even this smaller dosage not infrequently effected the prompt delivery of an egg. When injected at or near the hour of release of an egg from the ovary this same smaller dosage also sometimes prevents normal ovulation in the pigeon.

Experience has shown that an egg which has very recently entered the oviduct from the ovary can not be secured by this method. Injections rightly timed for this purpose result in the equivalent of an anti-peristalsis of the oviduct (ovum into body cavity); in the pigeon, however, it is easy to obtain prematurely eggs of somewhat more than 30 of the total 40 hours of oviducal development. As carried out by us the wildness of the bird is a factor in the interval of time from injection to laying. This results doubtless from the fact that, when kept close at hand for exact time records, the voluntary part of the act of expulsion is delayed or inhibited in the untamed birds.

It is evident that by this means eggs of various stages of immaturity—including successive eggs from the same parent—are made easily available for studies on the earlier stages of embryonic development; for experimental studies on these most modifiable stages; for chemical studies on various parts of the egg with less than the usual opportunities for change and admixture; and for isolating the functions of the various parts of the bird's oviduct. It is probable also that under certain conditions or limitations this reaction of the dove's oviduct—active and *in situ*—would be useful as a means of standardizing solutions of the active principle of the pituitary gland. Incidentally, it may be added that it has already been found practicable in this laboratory to utilize such prematurely laid eggs to make a crucial test of Stockard's[1] important suggestions on the cause of twinning and double-monster formation as these occur in birds.

[1] Stockard, C. R., *Amer. Jour. Anat.*, 1921, XXVIII., 115.

TABLE I

Data for One Series of Pituitrin Injections

Kind of Bird	No.	Dosage (in Thousandths of 1 c.c.)	Interval, Injection to Laying (Minutes)	No. of Hours Prematurely Laid
Ring-dove	1	22	25	4
	2	20	13	16
	3	22	8	16
	4	22	8	10
	5	22	14	10
	6	22	12	26
	7	22[1]	13	21
	8	22	Into b.c.	(37)
	9	28[2]	8	5
	10	20	6½	5
	11	10	Not laid	(34)
Common pigeon	12	44	13	18
	13	44	19	5
	14	44[1]	Some hrs.	+5
	15	44	22	5
Common fowl	16	264	(45)	?4
	17	2201	(33)	?4

OSCAR RIDDLE

THE DISCOVERY OF OLENELLUS FAUNA IN SOUTHEASTERN BRITISH COLUMBIA[1]

IN the spring of this year, Col. C. H. Pollen, of Cranbrook, British Columbia, forwarded to the University at Vancouver, specimens of chocolate-brown shales showing imprints of lower Cambrian trilobites.

In May, the writer visited the locality for the Geological Survey of Canada, made further collections and studied the stratigraphy over a wide area.

The fossils collected were submitted to Dr. Charles D. Walcott, secretary of the Smithsonian Institution, who identified the following genera and species:

Callavia, cf. *nevadensis* Walcott,
Wanneria n. sp. ?,
Mesonacis gilberti Meek,
Wanneria, cf. *walcottanus* (Wanner),
Olenellus, cf. *fremonti* Walcott,
Prototypus senectus Billings,

Dr. Walcott states concerning the collection:

[2] Injection repeated one or more times.

[1] Published with the permission of the Director, Geological Survey, Ottawa, Canada.

This fauna belongs to the upper portion of the Lower Cambrian, and it is essentially the same as that found above the tunnel at Mt. Stephen, B. C., and also found more or less all along the Cordilleran system down into southern Nevada.

The stratigraphy of the section is as follows:

Lower Cambrian	Chocolate-brown shales —*olenellus fauna*...	50 + feet
	fine-grained quartz conglomerate	300 + feet
	coarse conglomerate...	6 feet
	disconformity	
Precambrian Beltian	purple and green mud cracked siliceous metargillites (Siyeh)...	300 ± feet
	Purcell lava—amygdaloidal basalt........	100 feet
	purple and green mud cracked siliceous metargillite and siliceous limestones......	1,000 + feet
	(Siyeh formation)	

In the Cranbrook area the characteristics of the disconformity between the Cambrian and Precambrian are:

1. The thickness of the sediments between the Purcell lava and the basal conglomerate of the Lower Cambrian varies from a few feet to three hundred feet, showing evidence of an unconformity.

2. The upper surface of the Precambrian does not show any evidence of weathering before the deposition of the Lower Cambrian.

3. The Precambrian and Cambrian strata correspond in dip and strike. At no place were discordant relationships observed.

4. The metargillites of the Precambrian are more highly metamorphosed than those of the Cambrian.

5. The contrast in lithology between the Precambrian and Cambrian formations is very marked. Mud cracked and ripple marked purple and green metargillites are characteristic of the Precambrian while the Lower Cambrian rocks are white quartzose conglomerates succeeded by grey and chocolate-brown shales.

6. The basal conglomerates of the Cambrian contain rounded fragments of the underlying siliceous argillites.

A full detailed statement concerning the stratigraphical relationships of the Precambrian and the Cambrian over a wide area is now in course of preparation to be published by the Geological Survey of Canada.

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UNIVERSITY OF BRITISH COLUMBIA,
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HOWARDULA BENIGNA; A NEMA PARASITE OF THE CUCUMBER-BEETLE

Howardula[1] Cobb. Characters of *Aphelenchus* Bastian, 1865, but without œsophageal bulb and with a non-bulbous onchium and much reflexed ovary. "Female" finally a flaccid, cylindroid sack, without distinct alimentary canal, and otherwise much deteriorated. Syngonic; male unknown. *Howardula* may be related to *Bradynema* zur Strassen, 1892, but the latter has no onchium and even lacks a mouth opening.

1.1	(?)5.	(?)	95 '98.	(?)99.	3.5–5. mm
2.5	4.0	4.7	4.1	1.9	

Howardula benigna Cobb. Anus none or vestigial; vulva sometimes terminal; uterus nearly filling the body-cavity, posteriorly packed with larvæ and anteriorly with segmenting eggs, near the head in the vicinity of the small spermathecum narrowed and reflexed to the middle of the body, whence the narrow ovary turns forward and ends blind near the lead; onchium usually very obscure but the minute mouth opening still persisting. Inert, viviparous, usually all of the same stage of development in any individual host-insect, each when mature containing about two thousand embryos and segmenting eggs; the larvæ, apparently always all of one kind, sometimes ten to twenty thousand of them, proceeding from the mother nemas into the body-cavity, and into the sexual ap-

[1] Named for my distinguished friend Dr. L. O. Howard, chief of the U. S. Bureau of Entomology, president and past permanent secretary of the American Association for the Advancement of Science.

paratus, of the host, and so becoming deposited with the eggs of the latter.

Fig. 1. Shows relative volume of beetle and parasites. The line XY shows the actual length of the beetle.

The newborn larvæ measure as follows:

$$\frac{3.4 \quad (?)12. \quad 28. \quad -91. \quad (?)94.8}{2.3 \quad 3.2 \quad 3.7 \quad 2.8 \quad 2.2}\ 0.54\ \mathrm{mm}$$

Anus none or vestigial; tail conoid, straight, broadly rounded or subtruncate at the terminus. After deposition along with the beetle eggs, the young nemas moult with little increase in size, some of them then boring their way into the body-cavity of even very young larvæ of both sexes of the beetle, sometimes to the number of thirty but more often five or six. The following are the dimensions and other details of these young but already spermatized individuals, as found both in the soil and in very young beetle-larvæ, which in the body-cavity of the host reach the above, seven to ten times longer, mature form:

$$\frac{2. \quad 16. \quad (?)24. \quad \overset{75}{-}95. \quad (?)\ 97.}{2. \quad 4. \quad 5. \quad 4. \quad 2.6}\ 0.5\ \mathrm{mm}$$

Habitat: Common in the body-cavity (abdomen, thorax and even head) of *Diabrotica vittata, trivittata,* and *12-punctata,* especially the former, infesting the two sexes about equally.

My attention was called to this nema by Mr. W. V. Balduf, Assistant Entomologist, Ohio Agricultural Experiment Station, Marietta, Ohio, where he discovered the larvæ in

Fig. 2. Cucumber-beetle egg and the charge of nemas deposited with it.

the course of experiments on *Diabrotica.* Owing to the economic aspect of the subject, beetles sent me by Mr. Balduf were exhibited, dissected, at the Washington Helminthological Society's meeting, March 17, 1921. Examination revealed the adult female form, which is so flaccid and otherwise deceptive as to cause it rather easily to be confused with the internal organs of the host by one not versed in both insect and nema anatomy.

Aided by Dr. F. H. Chittenden and colleagues of the Federal Bureau of Entomology, and by others, the geographical distribution of the nema was studied with results shown on the accompanying map, which indicates that the distribution in 1921 is probably nearly coextensive with that of the main hosts, *Diabrotica vittata* Fab. and *trivittata* Mann. The nematism is often high and affects on the average about 20 per cent. (0 per cent.—70 per cent.) of the insects. Beetles from a locality where they are not nematized are larger and more vigorous. Thus twenty-five

beetles from an uninfested lot were much larger and averaged seventy per cent. heavier than a similarly chosen twenty-five from a fifty per cent. nematized lot. Anatomical evidence shows the infested female beetles to be less fertile than the non-infested, doubt as to diminished fecundity vanishing where the female host harbors a dozen or more adult nemas. In such cases the mere relative volume of the parasites is convincing evidence of handicap. See Fig. 1. Mr. Balduf in a letter speaks of beetles, many of which "died of nemas." I have no rigid proof of such deaths, but believe them very probable and at times numerous.

FIG. 3. The map-figures give the percentage of beetles found infested by *Howardula*. The figures for different localities a few miles apart in any given region usually were in substantial agreement. Where the percentage of infestation was highest, the nematism was highest, and vice versa. The presence of the nema does not exclude other internal parasites, such as other insects and gregarines. About 1,500 *D. vittata* were examined. Below are addresses of those who kindly contributed insects for examination.

Balduf, W. V., Marietta, O.
Cobb, Dr. F., Ann Arbor, Mich.
Cobb, V., Whitman, Mass.
Chapin, E. A., Falls Church, Va.
Fenton, E. A., Ames, Iowa.
Flint, W. P., Urbana, Ill.
Gentner, L., Lansing, Mich.
Hall, Dr. M. C., Chevy Chase, Md.
Harned, R. W., Agr. College, Miss.
Haseman, L., Columbia, Mo.
High, M. M., Kingsville, Tex.
Kelsall, A., Annapolis Royal, N. S.
Raps, E. M., Oakton, Va.
Riley, Wm. A., St. Paul, Minn.
Ross, W. A., Vineland Sta., Ont.
Smith, C. E., Baton Rouge, La.
Thomas, W. A., Chadbourn, N. C.
Walters, M. J., New London, Ct.
Watson, J. R., Birmingham, Ala.

In none of the numerous lots of beetles examined was the rate of infestation by any other zoo-parasite as high as by *Howardula*, with the single exception of a forty-three per cent. dipterous infestation; but no note was made of degrees of phyto-infestation (cucumber-wilt organism, etc.).

As many as thirteen thousand nema larvæ, by count, have been removed from the body-cavity of a single *Diabrotica vittata*, and no doubt the number may go much higher. On several occasions twenty or more adult Howardulas have been taken from a single beetle. Theoretically these should produce some forty thousand larvæ or more. The older female

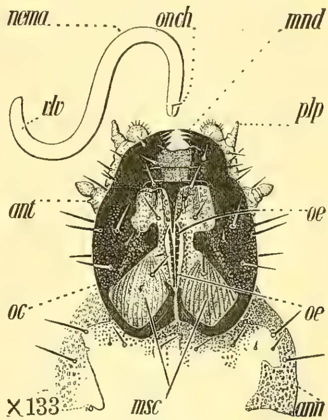


FIG. 4. Head of very young cucumber-beetle larva and of young *Howardula* at the time of its entrance. The mandibles of the grub, *mnd*, would seem to be impassable to the nema.

beetles, when nematized, deposit from a few to upwards of fifty of the nema larvæ with each egg. See Fig. 2. These soon mature on the eggs or in the soil (where they can live several weeks), moult, develop a more perfect spear, and by its aid begin to make their way into the body-cavity of the beetle grubs soon after the latter hatch out. That it is rather improbable the nemas enter the host by way of the mouth and alimentary canal is illustrated in Fig. 4. The active young beetle larvæ are armed with sharp-toothed, well developed mandibles. That the tender young nemas could pass so relatively small a throat and mouth, armed as the latter is, one hesitates to believe.

In plant-infesting triplonchs I have shown the development of the so-called salivary glands to be greatest in species noted for their efficiency in destroying the tissues of the host, and suggested that these glands aid in dissolving the host tissues and thus supplement the mechanical action of the spear or onchium, which therefore should then act also as a spewing channel. In light of this, it may not be without significance that the salivary glands of *Howardula benigna* appear better developed than in some of its nearest known relatives. Conceivably this secretion is also antiseptic. Nemas of very many kinds make their way through the tissues of their hosts without causing fatal infections. The existence of an antiseptic nema secretion or excretion might explain this. In the case of *Diabrotica,* there is no known trace left of the relatively large breach made by the parasite, a benignant result perhaps facilitated by the parasite itself in the way indicated.

The present investigations suggest how far we are from appreciating the abundance and importance of insect parasites and how backward in attempting their control. *Howardula* is, beyond any reasonable question, ages old, for on no other supposition can the remarkable relationship of host and parasite be explained. It is only one of a considerable number of parasites of the same destructive insect that have much to do with the welfare of the host. Intelligently increasing the incidence of the parasites decreases the ravages of the host. When we come to understand these relationships, these "balances" between host and parasite, doubtless we can do much toward inclining the "balance" in our favor. We hear more or less of organisms introduced to new areas without their enemies and parasites, and in consequence becoming frightful pests, and we have, very painfully and slowly it seems to some of us, learned that searching for and introducing these same enemies and parasites affords relief. Marked successes of this kind at least place it beyond doubt that this portion of the field of economic parasitology will be carefully explored. But there is another very important part of the field of which we hear little if anything, and that is the comprehension and watchful control of what may be termed indigenous or long-established "balances."

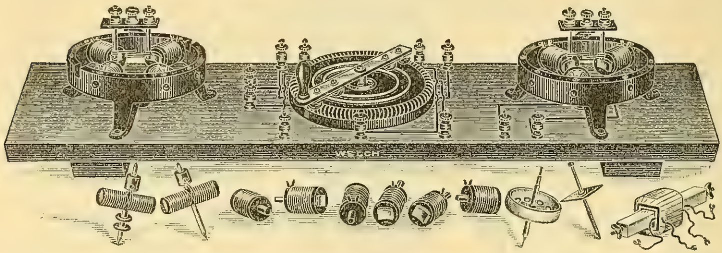
The cucumber-beetle affords good enough example of these latter to justify an appeal, on the basis of it, to economic biologists to scrutinize more carefully the ever changing "balances" between pests and their parasites and other enemies, *including pests of long standing,* with a view to keeping the "balance" always inclined in our favor. I believe any well trained, experienced and thoughtful biologist will agree that such a course is bound finally to result in notable economies. A case in point is the existence of localities, among those here tested, in which the total zoo-parasitic infestation of the beetles reached only about two per cent. At the same time not very far away there was a nema infestation exceeding fifty per cent. and a dipterous infestation exceeding forty per cent. The investigation showed that the transference by post of these two parasites from the highly infested areas to the low or non-infested areas was easily feasible at small cost. Posted in a ventilated box with a few cucurbit leaves the infested beetles undergo a two to four days' journey; set loose at night they survive without apparent injury.

N. A. Cobb
United States Department of Agriculture

Complete Dynamo Electric Machinery Apparatus

For Demonstrating

Direct Current Motors and Generators
Alternating Current Rotating Field and Induction Motor
The Rotary Converter
The Synchronous Motor
The Alternating Current Generator
The Transformer and Its Principles
Two or Three Phase Alternating Current Phenomena



This apparatus consists essentially of two fields which may be fitted with poles on which are wound coils and these fields may have 2, 4, or 6 poles for direct current work or 3 or 6 poles for three phase alternating current work

A simple direct current armature is supplied for mounting in this field and with this armature may be demonstrated a series or shunt wound motor or dynamo and all characteristics of direct current dynamo electric machinery of either 2, 4, or 6 poles. This furnishes much valuable information regarding the connections of the different poles, the direction of rotation, etc.

The aluminum cup for use in this magnetic field illustrates the principles of the closed circuit rotor for induction motors. The reversal of one of the field coils shows reversal of direction of rotation and other similar important principles may be shown.

The converter may be demonstrated by placing the armature which has slip rings on one side in the field shown on the right and arranging the poles and connecting a battery so as to run it as a direct current motor. The brushes underneath will collect alternating current and this may be used for ringing bells and may be shown to be alternating by the use of meters.

The Synchronous motor may be shown by carefully increasing the frequency of the alternating current generated by increasing the speed of the central handle and at the same time have the armature connected to this alternating current and the field coils in the proper order connected to direct current.

The alternating current generator may be demonstrated by energizing the fields by direct current and using the armature that has the slip rings on it.

One of these fields has two slots in it for holding a yoke on which are two concentric, removable coils and with this may be shown all the principles of the transformer, as transformation ratio, etc.

When used for alternating current work, that part of the apparatus which is mounted on the center of the base converts direct current into alternating current and there can be obtained either single phase, two phase or three phase current.

By the use of the polyphase current, a rotating field may be produced, and by the use of the mounted magnetic needle it may be shown how this needle is whirled around as the field rotates.

This set contains a minimum of parts but enables teaching of practically every application of either alternating or direct current, dynamo-electric power apparatus.

This outfit is complete with the two fields and the A. C. Generator mounted on a base and the following parts: 6 field coils, 1 direct current armature, 1 direct current armature with slip rings, 1 mounted magnetic needle, 1 aluminum cup rotor, 1 transformer yoke with both primary and secondary coils.

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W. M. WELCH SCIENTIFIC COMPANY

Manufacturers, Importers and Exporters of Scientific Apparatus and School Supplies

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